Knowledge & Scientific News

A MONTHLY JOURNAL OF SCIENCE.

Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., and E. S. GREW, M.A.

VOL. II. No. 9. [NEW SERIES.] AUGUST, 1905. [Entered at Stationers' Hall] SIXPENCE.

CONTENTS.—See Page VII.

The Sun in Calcium Light.

By WILLIAM J. S. LOCKYER, M.A., PH.D., F.R.A.S.

I.

SOME time ago an account was given in these pages (Vol. I., p 150), of some of the results which Prof. Hale had secured with the spectroheliograph he had so successfully designed and used in conjunction with the great refractor of the Yerkes Observatory.

This work, as I have pointed out elsewhere, marked a new epoch in solar physics, for it suggested possible fields for research which, up to that time, were not considered within the region of practical accomplishment. Thus, for instance, it is now possible to determine the distribution on the sun's disc and limb of such substances as calcium, hydrogen, iron, and many other materials, the lines in the spectrum of which are sufficiently strong in the solar spectrum. Not only can this question of distribution be minutely studied, but by securing photographs in different years the variation of the areas covered by these substances from year to year can be measured. In this way we have a method of estimating solar activity. Again, we are in the presence of a means of very considerably increasing our knowledge of sunspot formation because spots give us only a very brief span in the life history of a disturbed region, which can now be photographically traced long before any indication of a spot is detected and long after the spot itself has disappeared.

Further, a means is now afforded of rapidly securing the forms and positions of prominences on the solar disc at one exposure, either by using calcium, hydrogen, or, possibly, other lines for the investigation. By successive exposures on any particular portion of the limb comparatively rapid changes in prominences can also be photographically recorded.

These and many others are some among the numerous problems that are now waiting investigation by the aid of this powerful instrument of research, so that there is plenty of work for those students of Solar Physics who wish to participate in this field of inquiry.

At the present time there are not many of these instruments at work, or even in existence. In addition to those used by Prof. Hale in America, and M. Deslandres at Meudon, in France, Mr. Evershed, in England, has been securing some small scale pictures during the last few years; while at Potsdam another small instrument is mounted on an equatorial telescope. At the Solar Physics Observatory, South Kensington, a somewhat larger instrument than the last two mentioned has been at work during the past year, and nearly a duplicate of this has been despatched to India and is now in working order at the Kodiakanal Solar Physics Observatory.

There is every reason, then, to hope that before long more instruments will soon be erected and set in operation in order to assist in the accumulation of material for increasing our knowledge of the physics of the sun.

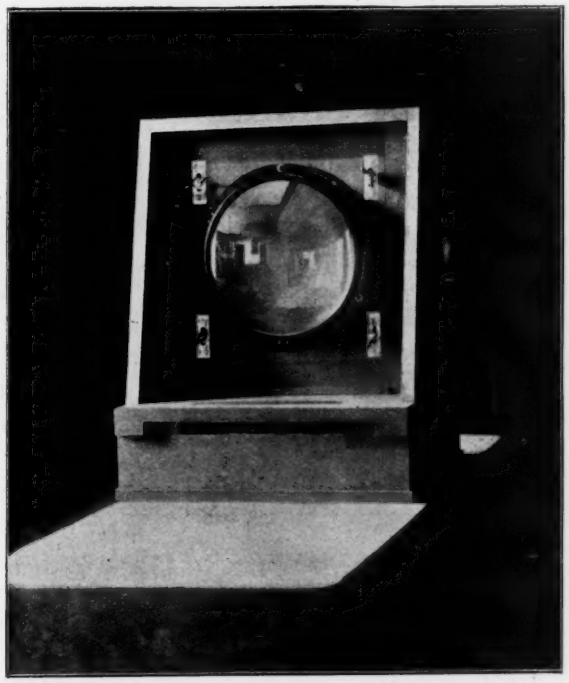


Fig. 1.—The 12-inch Taylor Photo-visual Lens and Support for forming the Solar Image on the Primary Slit of the Spectroheliograph.

In the following paragraphs it is proposed to briefly describe the South Kensington instrument and to refer at no great length to some of the results that have been gleaned from the photographs that were secured during the summer months of last year. A more complete account will be found in the Monthly Notices of the Royal Astronomical Society (Vol. lxv., p. 473), in a paper communicated by me during last March.

Unlike the spectroheliographs employed at the Yerkes and Potsdam Observatories, where both are worked in conjunction with equatorial telescopes, the one at South Kensington is so arranged that the solar image is formed by a lens (Fig. 1), on which sunlight is thrown

by means of a siderostat. In fact, the complete instrument consists of a siderostat to constantly throw the solar rays horizontally in a due south direction, a lens to form the image of the sun, and the spectroheliograph to obtain monochromatic pictures of this image.

The siderostat (Fig. 2) has a mirror of 18 inches diameter, and the lens an aperture of 12 inches, with a focal length of 18 feet. The solar image thus formed has a diameter of 2 1-7th inches, which is the same size as that of the monochromatic image photographed.

To secure the latter the optical arrangement is as follows:—The stationary solar image falls on a slit plate with jaws, 3 inches long, mounted at the north end of a tube, while at the other end of this tube is a lens 4 inches aperture and 6 feet focal length; this forms the collimater. The light, after traversing this collimater, then impinges on a plane vertical mirror and is reflected on to a prism. This prism is so placed that the light, after passing through it, falls on to another 4-inch object glass of 6 feet focal length, mounted at one end of another tube similar and parallel to the collimater. In the focal plane of this objective, in which a spectrum is formed, a second slit with jaws $3\frac{1}{2}$ inches long is placed in position. By so adjusting this secondary slit any particular line in the spectrum can be made to pass through the jaws by itself. In this way a line in the spectrum of calcium, or hydrogen, or iron, &c., can be isolated. The lines of the spectrum formed in the above manner are not straight but curved, so that it becomes necessary to employ a slit, the jaws of which are curved to the same amount. Such a slit requires,

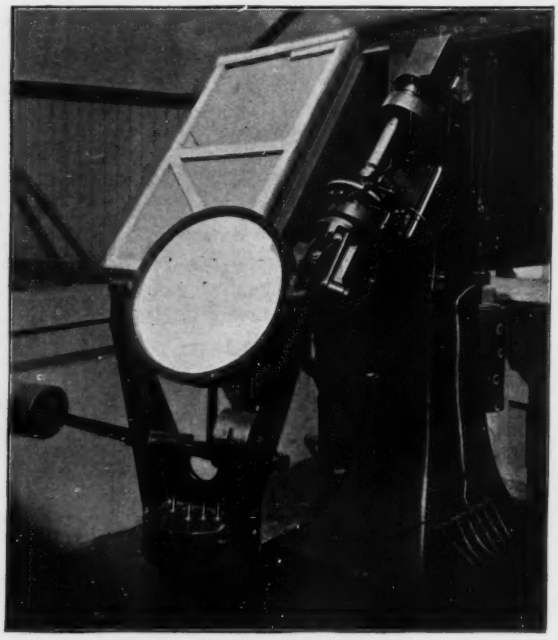


Fig. 2.—General View of the Large Siderostat showing the 18-inch Plane Mirror. The upper portion of the House is here moved on its rails towards the north.

in consequence, very careful adjustment, and the means adopted for placing the jaws in any required position can be well seen in the accompanying figure (Fig. 3).

By means, then, of the above optical arrangement, any particular strip of the sun's image which passes through the jaws of the first or primary slit issues through the secondary slit as light of one wave-length or colour.

If the whole spectroheliograph be gradually moved across the solar image different strips would enter the

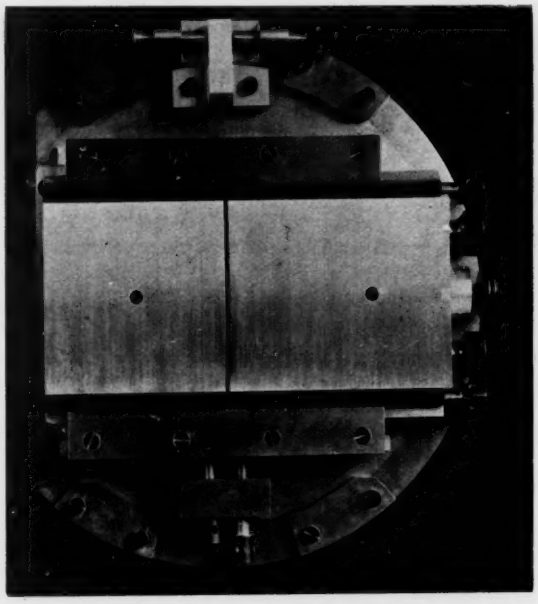


Fig. 3.—The "Secondary" Slit, showing the various Screw-adjustments available for setting the curved jaws exactly on the "K" line.

primary slit, and they would build up a picture of the sun in one wave-length at the second slit.

In order to produce this change of position in relation to the fixed solar image, the slits and optical parts are mounted bodily on a movable platform. This platform (see Plate 1, Fig. 1) rests on three balls, each of which is capable of movement between steel surfaces, the lower ones being fixed to the upper surface of another triangular framework supported by three concrete columns. To ensure *uniform* motion—a very important consideration—the movement, which is produced by falling weights, is controlled by the flow of oil through an aperture, the size of which can be varied at will. The direction of the motion required, namely, that in a horizontal direction and at right angles to the axis of the solar beam falling on the primary slit, is obtained by pressure of the upper platform against a guide bar fixed on the lower framework in the correct direction. The photographic plate, like the solar image on the primary slit, must be fixed relatively to the spectroheliograph. This is accomplished by placing firmly on the concrete column a vertical mahogany slide into which the plate holder can be placed as close up to the secondary slit as possible without actually touching any portion of it.

The method of procedure adopted to secure a disc picture with this apparatus is as follows:—

The adjustment of the secondary slit to isolate the centre of the "K" line being made, this slit is closed to the required width. The primary slit is next placed in the meridian and the solar image brought by the slow motions central on the slit. This image is then carefully adjusted for focus. The shutter behind the primary slit is then closed.

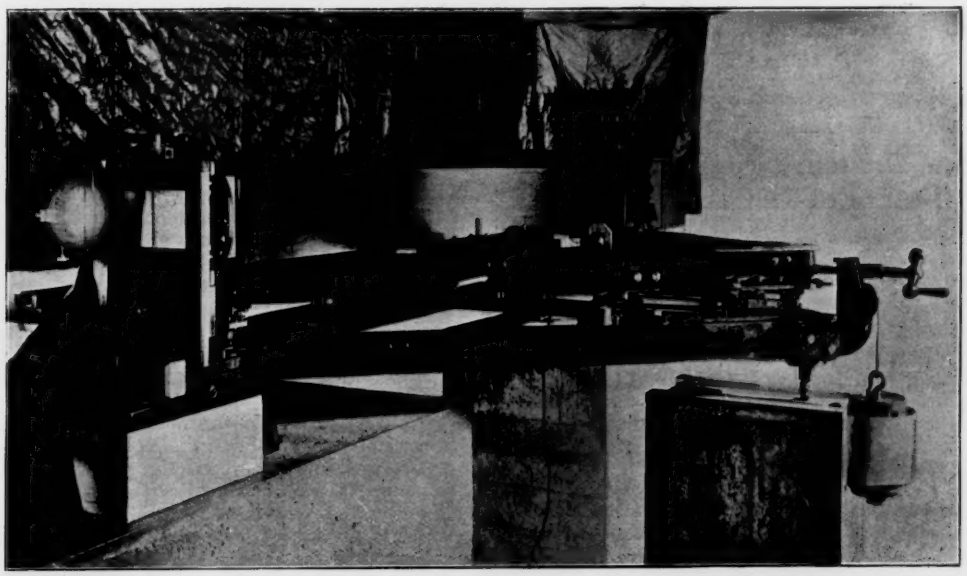
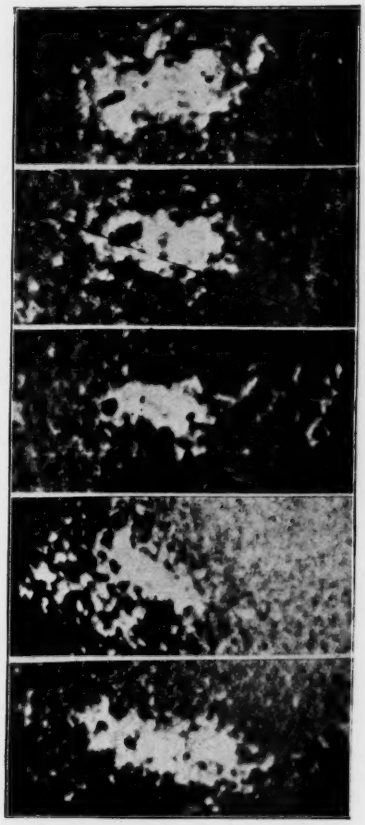


PLATE I. Fig. 1.



West. Fig. 3. East.

1904.
April 27th.
April 27th.
July 14th.
August 2nd.
August 29th.

1904.
May 23rd.
August 2nd.
Sept. 26th.
Sept. 26th.

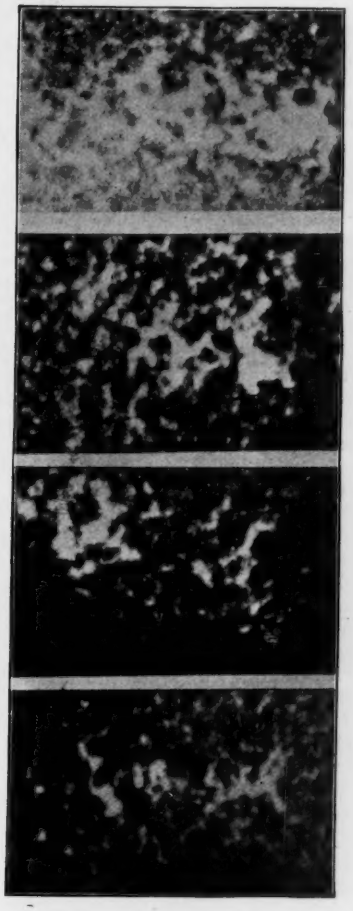


Fig. 2.

(To be continued in our next issue.)

The Nature of Life.

By GEOFFREY MARTIN, B.Sc. (LOND.).

III.—The Possible Significance of Alcohol Drinking.

WHEN a child I lived in a small town in South Wales. In the town the people spoke only English; in the remoter country districts the peasants still spoke Welsh.

The language that these peasants spoke had for me at that time no interest or significance.

It was a rude, imperfect dialect which was only spoken by uneducated people.

To me now, in after years, now different appears that rude peasant dialect! It signifies for me now the relics of a by-gone time when this poor dialect was a great world speech—such as English is now—and these rude peasants the representatives of a mighty people—the Kelts—whose armies swept in waves of living valour from out of Asia into lands so distant as Ireland, Spain, and Asia Minor.

Now what has worked the difference in my mental attitude? Solely increase of knowledge. When a child I knew nothing of the Kelts nor of their history. And so it is generally. A treatise on Bessel functions has no earthly interest for a Matabele warrior; the mathematical physicist is deeply interested in such a book; the interest of the mathematician is the result of a knowledge of the use and possibilities of such functions. The uninterest of the Matabele is due to his ignorance.

Many matters appear to possess no interest or importance to us simply because of our ignorance. Suitably viewed such facts become pregnant with world-wide consequences; for example, the blind hates and bitternesses which exist between peoples of different races has possibly no particular significance for the average man, except perhaps as a deplorable fact. To a scientist these racial hates inspire the greatest interest, for in his eyes they are but the outward play of those mysterious organic forces which cause evolution and the differentiation of species.

The almost universal drinking of alcohol, and the vice of drunkenness, which exists among all peoples and in all times of which we have any record, is another phenomenon of the same kind.

We propose here to review this last matter as a scientific problem, and gravely consider the physiological reason why men of all animals have this natural instinct after strong drinks most strongly developed.

Is it the manifestation of some great and imperfectly understood organic tendency, or is it only of the nature of a disease?

We proceed to discuss this question solely from a chemical standpoint.

One condition which seems indispensable for the manifestation of vital activity is fluidity. All living matter is bathed in fluids and it itself has a mobile semifluid constitution; all facts point to the conclusion that the condition of fluidity is intimately connected with life; it is even said that life first originated in the fluid sea and thence spread to land.

Certainly the observation that by far the greatest part of living matter consists of water, either free or combined, lends strength to this supposition.

The reason of this mobile and semifluid condition of living matter becomes manifest when we begin to study its chemical nature. Living matter is a complex system of atoms in eternal breakdown. The very condition of life seems change. Only in a semifluid condition can take place that continual redistribution of matter which, while preserving the form of living matter intact, supplies that flux of atoms which counterbalances its continuous decomposition.

Where the external physical conditions as regards temperature and pressure are such as to render the existence of matter in a fluid or semifluid condition impossible, then life as we know it would be incapable of existing. For example, at very low temperatures, all matter solidifies and the fluid condition as a phase becomes impossible. Even the most volatile gases first condense to liquids and then change to solids, so that at a temperature approaching the absolute zero we look out upon a frozen solid world.

The constitution of living matter must therefore be so adjusted to the external physical conditions as regards temperature and pressure that it continually maintains this condition of fluidity. When we contemplate the history of the world we find that these conditions have in former times been widely different from those which at present hold. There was a time when the world was a white-hot sea, when the moon had not yet been flung off by some mighty catastrophe from the revolving glowing mass. As ages passed the world cooled and cooled, until finally the temperature conditions which now reign were attained.

But the process of cooling is not finished; the world is still cooling and there will surely come a time when the average temperature of the world will sink from its present value (15° C) to 0° C, to − 10° C, − 100° C, and finally below the freezing point of hydrogen itself.

Even at the present time the temperature of the world is only slightly above that temperature at which all the water on the earth will pass into the solid condition. Indeed the process of solidification has already commenced. Vast regions are found where the water has already permanently passed into the solid condition; and the regions will extend with time until the seas and the mighty oceans themselves will freeze and be converted from top to bottom to a vast mass of ice.

Water will appear to the inhabitants of future days as solid deposits of mineral matter, presenting to them much the same appearance as the white masses of marble rocks in certain parts of the world appear to us.

At first sight it would appear that the effect this universal solidification of water will have upon the life of the earth in the form we know it will be its absolute destruction. For with the passage of water into a solid state the existence of living matter in a fluid or semifluid condition becomes impossible.

Water is one of the most volatile and important constituents of living matter; all the tissues are bathed in watery fluids, and by far the greatest portion of living matter is actually composed out of water. Upon the fluidity of water hangs the mobility and fluidity of living matter as we know it.

It is true that the freezing point of water may be lowered even to a considerable extent by the addition of impurities to it. For example, a mixture of water and salt can remain fluid at temperatures very much

lower than that at which pure water freezes. Yet even this artificial lowering of the freezing point of water will only enable us to stave off for a time its universal solidification in the tissues and the consequent passage of living matter into a solid frozen condition.

Were living matter a rigid unadaptable machine, one might well look with despair upon the prospects of life in the coming ages of cold and eternal night. Many facts we know, however, point to the conclusion that living matter posseses the power of adapting itself to changing external conditions; for example, it is a well-known observation that by gradually raising the temperature of water in which certain organisms live, we can in the course of time cause them to live and flourish in water so hot that specimens of the same organism which had not become acclimatised to the changed temperature are at once killed when placed therein. The question is, therefore, in what direction can living matter change its constitution in order to adapt itself to temperatures much below that at which water enters into a solid condition?

One thing appears certain. If living matter is to avoid being frozen hard with the falling temperature, the water as such must be gradually eliminated from the organism and its place taken by another liquid which remains fluid and mobile under conditions which render the existence of water as a fluid impossible.

Now is there any other fluid which perhaps could take the place of water in living matter and fulfil this condition? Alcohol seems to be such a fluid; alcohol freezes at -130° C, water at 0° C.

Moreover, of all the known compounds alcohol is the one which approaches both chemically and physically nearest to water in properties.

Both are mobile fluids; both are great solvents; both have a very similar constitution—alcohol, in fact, is water in which a hydrogen atom is replaced by the heavier radicle $C_2 H_5$, thus :—

$$\begin{matrix} H \\ H \end{matrix}\!>\!O \qquad\qquad \begin{matrix} C^2H^5 \\ H \end{matrix}\!>\!O$$

water. alcohol.

Alcohol can perform many of the functions of water; for example, just as water can combine with molecules to form "Water of Crystallisation," so also alcohol can, and we can likewise speak of "Alcohol of Crystallisation."

Moreover alcohol is, like water, though to an enormously smaller extent, associated with living matter.

It is the product of fermentation in enormous quantity by the lower forms of life, and occurs to a greater or less extent in fermented ripe plants and fruits.

It is, therefore, by no means inconceivable that alcohol could enter into the constitution of living matter to an enormously greater extent than it does at present, and thus replace the water as the fluid which bathes the tissues.

Moreover, there even seems to be at hand the mechanism by which such a replacement could be brought about; certain of the lower forms of life can manufacture alcohol as a product of their vital activity.

The whole phenomenon of alcoholic fermentation is an instance of this fabrication.

We have only to conceive that this fabrication of alcohol takes place to an increasing extent in the living body itself. These alcoholic ferments can be conceived to enter as the temperature falls to an increasing extent into the constitution of living matter, and thus to gradually increase the store of alcohol in the body itself. So that when the temperature falls below that at which water freezes, the watery fluids in the lower forms of life will have been replaced by fluids in which alcohol largely predominates, and which, therefore, remain fluid and mobile at a temperature whereat the plant would be frozen hard if it contained only water.

The age of water life would thus gradually pass into the age of alcohol life; and the cause of the variation would be the necessity for the organism to adapt itself to the altering external physical conditions by eliminating a less volatile for a more volatile fluid.

It is in the light of this conception that we approach the treatment of the question of alcohol drinking by the human race. It is well known that men in cold climates drink alcohol in a more concentrated form than the men of warmer lands.

Coldness, in fact, seems instinctively to drive men to alcohol. And if the temperature of the world is gradually reduced, so as to replace a temperate climate by a colder one, doubtless this tendency would be greatly intensified.

I can easily imagine a process by which man first began by drinking only water—as the lower animals do now; then by drinking water with a little alcohol in it, as man does now; then as the world grew colder and colder age by age, the amount of alcohol in the drink gradually increased until ages hence man will have evolved into a creature which will drink only alcohol. Together with the increase in the alcohol in the fluids man consumed, the quantity of alcohol in the fluids of the body increased, and the quantity of water diminished, until ultimately in the course of ages the constituents of the fluids of the tissues so altered that the water was entirely replaced by alcohol. The process of evolution would then be complete; a less volatile fluid would be replaced by a more volatile one, by a process probably of the same nature that caused the less volatile elements such as sulphur, phosphorus and silicon, to be replaced by the more volatile ones such as oxygen, nitrogen, carbon, and hydrogen.

Water would then exist in mere traces in the body, much as S does now, as the relics of a bygone time when it assumed a far greater importance in living matter than it does at the present time.

Is not this tendency men have to abstain from drinking pure water and to drink instead alcoholic beverages nothing else than the beginning of the gradual replacement of the water in the human body by alcohol?

Viewed in this light the phenomenon of alcoholism assumes the greatest interest and importance, as the possible manifestation of a mighty organic change sweeping slowly but irresistibly over the whole of living matter.

It may be, however, that some other fluid—for example, an oily liquid such as is found in great quantities in the bodies of fishes which live in cold seas—and not alcohol, would be the liquid which will ultimately replace water in living matter. Whether this be so or not, one thing, I think, is almost certain, and that is that if life is to continue at much lower temperatures than those which hold normally upon the earth, the water must be eliminated and its place taken by another liquid harder to freeze.

We beg to call the attention of regular readers to the new system of Subscription announced on page X.

The Induction Pump.

With Suggestions as to Reversal in Influence Machines.

By CHARLES E. BENHAM.

IN two previous articles published in "KNOWLEDGE" (November, 1904, and May, 1905) some simple experiments in electric induction were described, the general principle of which was that of the original "doubler" of Abraham Bennet, and also to some extent that of the majority of devices which succeeded the doubler, with a view to render the multiplied-charge process available in a practical way. Such devices include the machines invented by Varley, Toepler, Voss, and others, as well as such modifications as Lord Kelvin's water dropping apparatus, and finally the admirable arrangement adopted by Mr. Wimshurst, and known by his name.

The multiplying process, by which these machines acquire such powerful electric charges, is briefly attributable to the fact that while an insulated charged body can confer, by induction, without losing its own electricity, successive charges of opposite sign upon two or more conductors successively earthed when near it, it can obviously be made to receive in return an increase of its own charge if it in turn is placed within the inductive sphere of those two or more charged bodies so that they all re-act upon it simultaneously. This is the principle that underlies the action of most of the influence machines, the difference being chiefly in the way in which this cycle of action and re-action is brought about.

It was shown in the experiments already referred to that there are alternative ways of carrying out the process. For instance, the simultaneous re-action of two or more inductively charged bodies may be provided for either by bringing them into actual contact

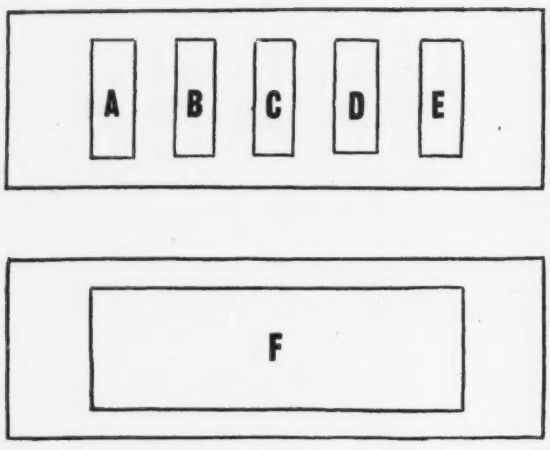


Fig. 1.

with each other by super-position, or by merely placing the conductor that has to receive their conjoint influence in an intermediate position so as to be within the sphere of all of them. The latter process lends itself more readily to practical application. For example, if a series of strips of tinfoil are attached to the under side of a piece of glass, as in Fig 1, A, B, C, D, E, they may each be given an induced charge by the single piece of insulated tinfoil F, on the upper side of a similar glass, if this plate is drawn successively over A, B, C, D, and E, earthing each as the front edge of F passes over it. Then, placing the plate bearing F over the other, and touching F, it receives from A, B, C, D, and E a combined influence, increasing its original charge. On repeating this cycle a few times the tinfoils, which had no measurable initial charge, become strongly electrified, the sign of F's electricity being the opposite of that of A, B, C, D, and E. Reducing the experiment to a still simpler form, the tinfoils A, B, C, D, and E may be dispensed with, and the finger may be placed on the under side of the plain glass instead, drawing it along as F is moved, so that it successively occupies the posi-

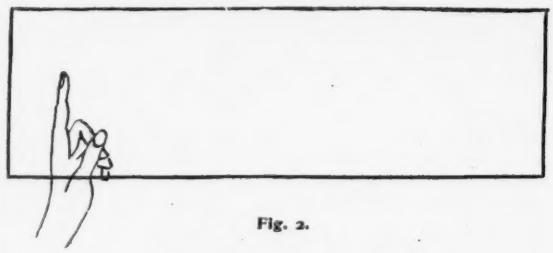


Fig. 2.

tions of A, B, C, D, and E (see Fig 2), and it will do duty for the tinfoils. The charge is retained by the glass surface, and after a few strokes from end to end, alternated with earthings of the upper tinfoil, the charges will accumulate. There is no need to move the upper plate at all during the charging process. Let it rest on the plain glass, and draw the outstretched finger lightly over the under surface of this several times, each time touching the upper tinfoil after the operation, and a considerable charge will accumulate on the upper plate and will be given off by its tinfoil when the two plates are parted and a conductor is presented to the upper one. That the charge is not due to friction from drawing the finger over the lower glass is evident from the fact that sometimes the charges will be positive and sometimes negative on the upper plate.

This variation of the polarity is very curious, and it is difficult to associate it with a definite cause. Two such pairs of induction plates may be made exactly alike, and kept near each other under precisely similar conditions. On testing their action at different times the upper plates of the two pairs will sometimes be found oppositely charged and sometimes similarly. A number of observations made at various times of the day, and under various atmospheric conditions, failed to show any agreement of behaviour on the part of the two pairs of plates. Sometimes they would retain the same polarity for several days. Sometimes one would change every few hours and the other would continue constant for a long while. At other times each would vary at very short intervals, and occasionally one would be so inconstant that it was difficult to make it acquire an accumulated charge. In 70 observations taken at various times of the day during the space of a week, the upper

plates of the two pairs of inductors gave the following results :—

First pair.	Second pair.
43 times negative.	53 times negative.
26 times positive.	17 times positive.
1 time variable.	

The induced charge of the upper plate was thus more frequently negative than positive in both cases. If the charge had been due to friction by drawing the finger along the under plate, that plate, being well coated with shellac, would have been charged negatively, and the induced electricity in the upper plate would have been positive, showing again that the charge could not have been initiated by friction.

As is well known, the Wimshurst machine, or any other self-exciting influence machine, is in the same way variable as to the polarity it will assume at starting after it has been left at rest for some time.

Returning now to the experiments described in the two former articles, the object of the present contribution is to explain how the same process (briefly recapitulated above) may be utilised more effectively for

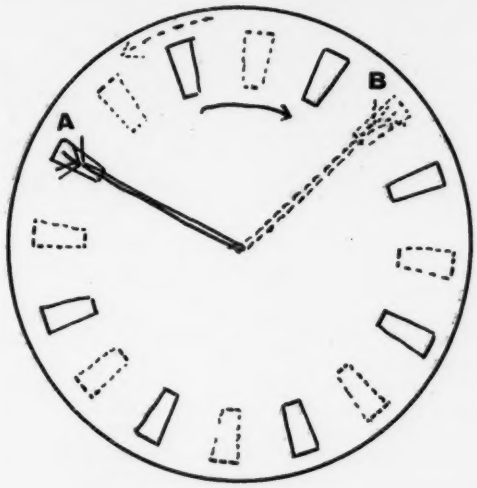


Fig. 3.

pumping up from the earth really practical supplies of electricity; how, in fact, a machine may be made on this principle, and incidentally how such a machine as the Wimshurst is a contrivance of this very character.

In the Wimshurst the disposition of the brushes and oppositely rotating discs gives, as was shown in the first article, a double multiplying arrangement of character similar to that which we have performed by hand more tediously in the experiments that have been described in this and the preceding articles. It follows, indeed, that two oppositely rotating discs, with sectors, as in the Wimshurst, ought, theoretically, to become charged with electricity of opposite sign with only a single brush to each disc placed as at A and B (Fig. 3).

A moment's consideration of this diagram will show that the directions of rotation of the respective discs being as shown by the arrows, the sectors successively charged by induction at the brush A will (two or three of them at least) re-act simultaneously on the other plate at B, when they have travelled to the position in front of that brush. Inversely the sectors charged successively at B will several of them act simultaneously upon the sector at A, when they have reached that spot. At A and B, therefore, there will be two points at which continually increasing induction charges of opposite sign will be received. It will be found, indeed, that, arranging the Wimshurst apparatus in this way, with only two brushes, theory is exactly borne out by experience. The brushes promptly glow, and the two discs are oppositely charged. It is this latter fact, however, that renders their charge unavailable under such conditions. The opposite charges of the two discs hold each other "bound," and consequently the collectors are not able to draw off any charge from the plates when arranged in this way with the two single brushes. The four brushes of the Wimshurst provide for opposite charges on different parts of each disc, with a consequence that at certain parts of the revolution (where the collecting combs are placed) the adjacent part of each disc is charged with electricity of the same sign, and this, of course, is not "bound," but is readily taken off by the collectors. It is in this way that the Wimshurst machine is so efficiently adapted to its purpose, the charges being "bound" at such portions of the revolution as is appropriate, and set free only at such portions as are necessary for collection of the charge.

It is, however, obvious that if it were possible to

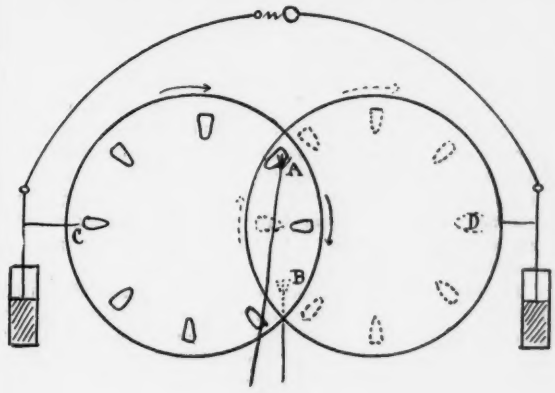


Fig. 4.

liberate the "bound" charges on the two discs arranged with the two single brushes as shown in Fig 3, we should have an efficient accumulator capable of charging jars, as in the case of the Wimshurst.

This liberation can be effected by providing that a portion of each disc shall be removed from its companion's influence. If, for example, the discs are placed as in Fig 4, the induction can still be effected by placing brushes at A and B, where the discs overlap, while the collecting can be accomplished at the free parts of the discs, viz., at C and D. It will be necessary, however, in order that the sectors may travel past each other in opposite directions, that the discs themselves should both rotate the same way, as shown by the arrows in the diagram.

This device is a true induction pump, drawing, in chain pump fashion, from the earth contrary electricities in each of the respective discs with its circle of sectors.

Two discs of 16 inches diameter arranged in this way, with 24 sectors on each, will give a torrent of 5-inch sparks, and the machine is readily self-exciting.

A troublesome, and perhaps unexpected, difficulty,

XUM

however, occurs, which must be got over if the machine is to be of practical service—the tendency to a reversal of polarity during working. The remedy is easily provided by placing additional brushes to touch the sectors after they have passed the collector brushes; that is, at the top of one disc and at the bottom of the other. The reason for this will appear presently when reversal has been explained.

The defect of reversal is one that occurs more or less in nearly all influence machines except the Wimshurst, and the cause, though extremely simple, seems to have escaped general detection, so that much more mystery has been attached to it than is necessary.

Reversal is an obvious consequence of the induction which each charged disc exercises on its own earthed sector—the "self-induction" of the disc as it may be called. Each sector, at earthing, is under the influence not only of induction from the opposite disc, but also of induction from the contiguous surface of its own disc, and as the charge increases this inductive influence from its own disc at last overpowers that from the opposite disc, and so effects a charge of reversed sign. Holtz's memorable observation that when a metal comb is drawn over a highly charged glass plate a charge of opposite sign is left on the glass is only a special case of self-induction with consequent reversal.

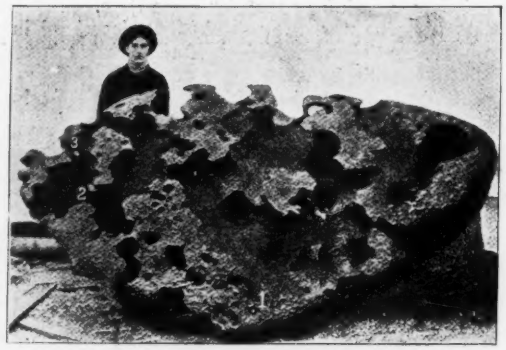
The most satisfactory way to prevent this self-inductive influence would obviously be to keep the electricities of each disc "bound," except at the collectors. "Bound" electricity does not induce a charge in adjacent bodies. It is only when electricity is free that it is competent to do this. Now, as has already been pointed out, in the Wimshurst machine the electricities of each disc are held "bound" except at the collectors, and that is why self-induction, with consequent reversal, does not occur in the Wimshurst except under very strained conditions, while with the Voss and most other influence machines reversal is a constant source of trouble.

In the induction pump, which has been described above, the sectors of the overlapping portions of the disc have their charges "bound," and these are, therefore, incompetent to produce self-induction, but the sectors that precede the induction brushes are charged with free electricity, and it is when their charge is great that they are able to induce a reversed charge. To prevent this the additional brushes have to be provided as already described in order to neutralise the sectors at these portions of the discs' orbits.

There is one possibility with regard to self-induction that is worth considering, viz., the possibility of rendering it of service instead of preventing it as a hindrance. It is well known that Holtz turned it to account by utilising the charge of opposite sign which he found was left on a charged plate after passing a metal comb. A suggestive parallel to the self-induction of a charged disc occurs in dynamical electricity in the phenomenon named by Faraday the "self-induction" of the coil, *i.e.*, the inductive influence of each winding of the coil on the next winding. The question is whether, as in that case the self-induction of the coil is made to produce the "extra current," in some similar way the self-induction of the disc might not be made to produce "extra charge," and so made advantageous to the output. To effect this a machine totally different in construction from any of the present influence machines would have to be devised, but the problem is worth considering in view of the advantages which influence machines offer over the induction coil for X-ray work and even for wireless telegraphy.

The Great Meteorite of Willamette.

A FULL and interesting description is given in *Cosmos* of this meteorite, found in the hills of Western Oregon in 1902, and we reproduce one of the illustrations. This clearly shows the peculiar honeycombing of the base, the cause of which has been a matter of some speculation. The conditions contributing to affect the surface of the meteorite are peculiar. The air in front of it, during its rapid progress to the earth, is compressed to such an extent that it becomes almost like a solid body. The speed attained is calculated to be something like 50 miles a second. The friction should generate a temperature of about 5,000° Centigrade, sufficient to melt any material of which the meteorite is composed. This is mostly iron, with a small amount of nickel. The deep holes and furrows in the stone are, however, more probably the result of disintegration through chemical and atmospheric action on the earth. The meteorite, which is 10 feet in greatest length, weighs 13½ tons.



"A Raised Beach in Anglesey."

TO THE EDITORS OF "KNOWLEDGE."

DEAR SIRS,—In your issue for July last, Prof. Bryan, F.R.S., refers to what he calls a "raised beach" resting upon boulder clay between Beaumaris and Penmon, Anglesey.

Beds of sand similar to that described by Prof. Bryan can be seen at Llanddona, Cemaes, and other places round the coast of the island; and at Towyn Trewan, Aberffraw and Newborough large tracts of land have been covered with sand. But surely these sands cannot be called "raised beaches" in any other sense than that of having been raised by the wind.

I do not doubt the facts mentioned by Prof. Bryan, but we must get stronger evidence than that of these "raised beaches" to establish the conclusion that "changes have taken place in the level of the earth," especially when we are dealing with a portion of the earth that has clearly been remarkably stable all along the geological ages from Pre-cambrian times to the present.

Yours faithfully,

W. EDWARDS.

University College, Aberystwyth, July 24, 1905.

The Simplest Kind of Protoplasm.

A Note on the Free Growth of Bacteria and Torulæ in a solution of Neutral Ammonium Tartrate in Distilled Water.

By H. CHARLTON BASTIAN, M.A., M.D., F.R.S.

IN his work on "The Structure and Functions of Bacteria," Prof. A. Fischer places the nitrifying Bacteria that were discovered and isolated in 1888-91 by Winogradsky among his group of "Prototrophic Bacteria." He says their life-processes are "characterised by an extremely primitive metabolism—a physiological humility which shows them to occupy the very lowest rung of the ladder of life." While on another page* he says the materials from which they build up their cells are "inorganic compounds of the very simplest character, carbon dioxide and ammonia, or nitrous acid, with a few mineral salts. They are thus prototrophic in the strictest sense of the word, for a simpler synthesis of proteids than theirs is scarcely conceivable." He further says:—"As might be expected in the case of organisms with oxidising functions, all the nitrifying Bacteria are ærobic. They require no light, and yet, in spite of this, are able to assimilate the CO_2 of the atmosphere."

His other two groups of Bacteria are supposed to be absolutely separated from this primitive group: the "Metatrophic Bacteria," under which are included most of the known forms, because they "cannot live unless they have organic substances at their disposal, both nitrogenous and carbonaceous"; and the "Paratrophic Bacteria," because they "can exist only within the living tissues of other organisms," that is, as true parasites.

It is the object of this article, however, to show (1) that a sharp distinction between these first two groups does not exist, seeing that common "Metatrophic Bacteria," as well as some Torulæ are capable of taking on life-processes even simpler than those shown by any of the hitherto described forms of the "Prototrophic Bacteria"; and (2) of showing further that such simplest of all life-processes are not of ærobic type.

The verification of these statements can be easily made. It will only be necessary to prepare solutions of neutral ammonium tartrate in distilled water, using about 0.65 of a gramme of the salt to 30 cubic centimetres of the water (that is ten grains to the ounce), and often the crystals have been dissolved to add to one of the solutions a single drop of a recently prepared turbid hay infusion, and to another a single drop of a recently prepared turbid infusion made from beef or mutton. The two solutions thus inoculated with common active Bacteria may then be placed in the dark within an incubator, maintained at a temperature of 30°—32° C. (86°—89° F.). In about 36 hours both fluids will be found to have become slightly opalescent, owing to the growth, as the microscope will show, of myriads of minute Bacteria, and occasionally of a number of very minute Torulæ.

Though these common Bacteria and Torulæ are thus capable of growing freely in the saline solution without the aid of light, I have found that light distinctly favours the process, since solutions similarly inoculated and left exposed to ordinary daylight have become turbid rather more quickly, even though the temperature to which the solutions has been exposed has been about 11° C. (20° F.) lower than that of the incubator.

In order to get rid of the complication caused by the presence even of a single drop of an organic infusion, such as was present at first, other solutions may be inoculated with Bacteria taken from one of the original solutions after five or six days, when their turbidity has become more marked. As the Bacteria in these solutions are probably less numerous and less vigorous than those in the organic infusions, three drops (rather than one) are now introduced into each of two other freshly-prepared ammonium tartrate solutions, one of which may be placed in the incubator as before, and the other left in a corked flask exposed to daylight; and at the lower temperature. The growth of these less vigorous Bacteria is now decidedly less rapid, and seems only capable of occurring at all freely when aided by daylight. In the flask on the table the fluid will become slightly opalescent in four or five days, and this opalescence increases for a few days, when a sediment begins to form. But the fluid in the incubator may show no distinct opalescence, even for a couple of weeks or more, though a very minute amount of sediment will accumulate.

Examination of the sediment taken from one of these second inoculation flasks which has been exposed to daylight will show masses of Bacteria, mixed with Torulæ or other Fungus spores, together with a delicate, much-twisted mycelium, as shown in Fig. 1.

So far there is nothing to show that the Bacteria and Torulæ which grow freely in the simple ammoniacal solution are not—as "Prototrophic Bacteria" generally are said to be—ærobic organisms taking their CO_2 from the atmosphere. That point, however, was settled by me as long ago as 1871, when I showed* that a solution of the same kind in a flask with a narrow neck might, with the aid of an air pump, be boiled at a temperature of about 90°F. (so as not to injure the organisms already contained in the fluid), and when the air had thus been expelled, the neck of the flask might be sealed during ebullition, by aid of the blow-pipe flame. Experiments conducted in this way showed that in the course of a few days the fluids became opalescent in the usual way within these sealed, airless flasks, and the microscope revealed the usual swarms of Bacteria. There was no mention in these experiments of Torulæ having been found—though I have little doubt that some of them were also present, as these organisms are well known to be generally anærobic in their mode of growth.

My claim that the organisms growing in this solution of ammonium tartrate in distilled water are building up protoplasm in the simplest known manner may be objected to on the ground of the ultimate organic origin of the tartaric acid, but I am told by Sir William Ramsay that "ammonium tartrate can be synthesised from inorganic material, and this substance is, so far as we know, absolutely identical with ammonium tartrate derived from tartaric acid extracted from wine-lees."

Seeing that the formula of neutral ammonium tartrate is $(NH_4)_2\ C_4\ H_4\ O_4$, if there were no impurity in the solution, the micro-organisms would have to build up their protoplasm in some way with the aid only of C, H, O, and N—which seems almost incredible. I may say that the ammonium tartrate used was specially

* *Loc. Cit. Transln*, 1900, pp. 48 and 106.

**The Modes of Origin of Lowest Organisms*, p. 90.

XUM

prepared for me, some years since, by Messrs. Hopkin and Williams, and that the solutions were made in small flasks of hard, Bohemian glass. Such solutions were formerly twice analysed for me by a skilled chemist, who reported that not the least trace of either sulphur or phosphorus could be detected. Sir William Ramsay has, however, been kind enough to analyse another specimen of the solution for me after it had been in the flask for five days* and his report is that the "liquid contained an excessively minute trace of sulphur, probably as sulphate; but no phosphoric acid could be detected by the molybdate of ammonium test."

Looking, therefore, to the fact that the nitrifying Bacteria would have at their disposal the "few mineral salts" referred to by Fischer, we may safely assume that the micro-organisms growing in this solution of ammonium tartrate, contaminated only by an "excessively minute trace of sulphur," have, in reality, been building up the simplest known variety of protoplasm.

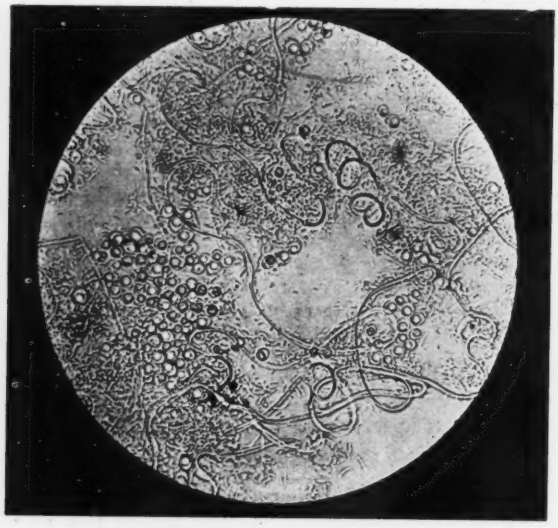


Fig. 1 (x 375).

But how much the process would be aided by a little phosphorus may easily be shown by the addition of three grains of sodium phosphate to the solution. An inoculated ammonium tartrate solution with this addition will become turbid more quickly, and will soon yield a far larger amount of micro-organisms.

This subject seems to me one chiefly of biological and chemical interest, and to be of altogether less importance on its botanical side. Looking to the nature of the primary inoculating material, it was only to be expected that several different kinds of common Bacteria would be found growing in the solutions, and this has proved to be the case. Dr. Gordon Holmes, the Director of the "Research Fund" at the National Hospital, kindly made a gelatine plate-culture from a second fluid, the first having been inoculated with a drop of a turbid hay infusion, and he reports that there were at least seven different kinds of Bacteria found —Cocci, Diplococci, Bacilli, and a kind of Streptothrix; while a miroscopical examination of some of the sediment from the same flask showed, n addition to abundance of Bacteria, a large number of Fungus spores, together with a peculiar spiral and twisted mycelium, such as may be seen in Fig. 1.

It certainly is very remarkable that these common micro-organisms, previously carrying on their life processes in organic infusions, should be able so rapidly to adapt themselves to an entirely different metabolism. It is much to be desired that some skilled chemists should take the matter up, and endeavour to throw some light upon the steps by which this marvellously simple synthesis of living matter is brought about.

*The Solution was one which had been inoculated with three drops from a first solution, and, having been in the dark incubator, it showed no trace of opalescence.

Star Map.—No. 6.

Leo, Cancer.

THIS map may be of special interest this month, since it shows the region in which the Sun will be at the time of the eclipse on August 30. The Sun's R.A. (on the Ecliptic) will then be X. h. 32 m., so that it will be close to ρ Leonis, and within about 7° of Regulus. Mercury at that time will be within 4° of the Sun, S. of 48 Leonis. Venus will also be within the map, on the borders of Gemini and Cancer. Dec. 19° 57′ 40″.

In the upper left-hand corner are some of the principal stars of the Great Bear, while to the right lay the "Twins," Castor and Pollux, and lower down is Procyon.

Among the more specially interesting objects included are—

α *Geminorum* (*Castor*) VII. h. 28 m. + 32° 5′. A complicated system. A double star, magnitudes 2·0 and 2·8, distant 5″·7. One of these stars is also found to be a spectroscopic binary with a large dark companion, while a smaller and more distant star shares in the proper motion.

α *Canis Minoris* (*Procyon*), VII. h. 34 m. + 5° 28′. Magnitude 0·5. Has a faint but massive companion star, which was one of the first "dark" stars discovered (in 1840).

ζ *Cancri*, VIII. h. 6 m. + 17° 59′. This is another complication of several stars. Two stars of 5 and 5·7 magnitudes revolve around one another in 60 years at a distance of less than 1″. A third star, of 5·5 magnitude, revolves around these in an opposite direction, and accompanying this is a dark companion.

ϵ *Hydræ*, VIII. h. 42 m. + 6° 50′. A triple star. Two, of magnitudes 4 and 6, are only 0″·13 apart, and present a yellow colour. The third star, of 7th magnitude and distant 3″·47, is blue.

α *Leonis* (*Regulus*), X. h. 3 m. + 12° 25′. Magnitude 1·3.

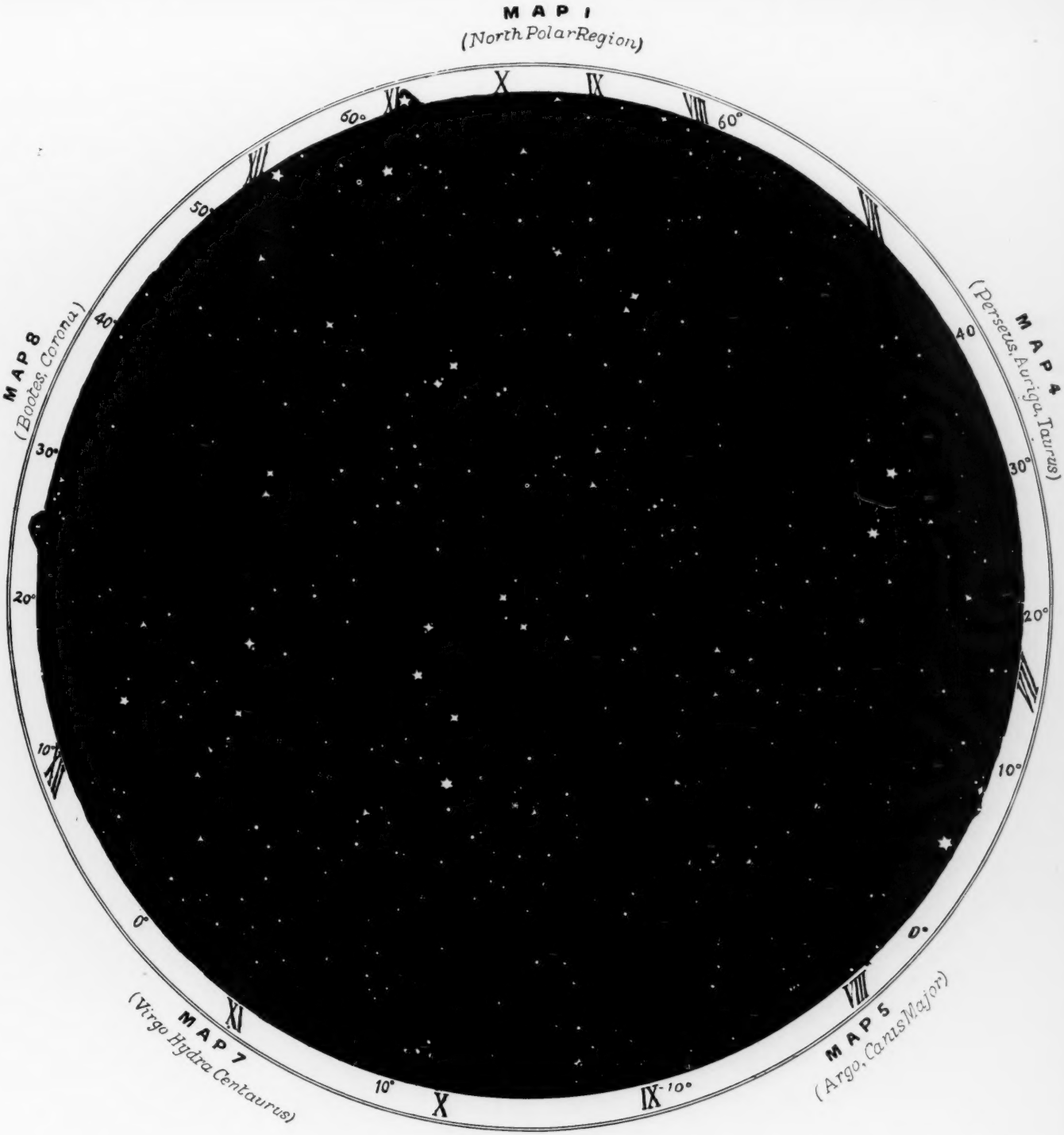
γ *Leonis* (*Algeiba*), X. h. 14 m. + 20° 19′. A double star, magnitudes 2 and 4, distant 3″·8. Yellow colour.

ξ *Ursæ Majoris*, XI. h. 13 m. + 32° 6′. A double star of 4th and 5th magnitude, distant 2″·3.

Leonis, XI. h. 19 m. + 11° 5′. A double star, yellow and blue, distant 2″·17.

1830 Groombridge (mag. 6·4), XI. h. 46 m. + 51° 30′, has the greatest proper motion of any star, amounting to 3″·98 in R.A. and + 5″·8 in decln.

In the centre of Cancer is the large cluster, not nebulous, known as Præsepe, "the Manger" (Ptolemy), or, according to some authorities, the "Beehive." Visible to the naked eye as a small cloud. Forty-five stars have been definitely located.



BRIGHTNESS.

- 1st Mag.
- 2nd ,,
- 3rd ,,
- 4th ,,
- 5th ,,
- 6th ,,
- Variable.
- Nebula.

MAP No. 6.

Leo, Cancer.

XUM

XUM

The International Ornithological Congress

By W. P. PYCRAFT.

THE Fourth International Ornithological Congress ended on June 17th, a really memorable session. The standard of papers presented was a high one, and though, perhaps, striking originality of thought, save in one or two cases, is not conspicuous among them, yet almost all show the grip of the specialist, a thing much to be desired, if the specialist have the knack, which many certainly do not have, of making himself intelligible to his fellow-workers in other fields.

Of the President's address we can say but little, for the President himself said little, rightly remarking that this could best be digested after its appearance in print. He chose to divide his discourse between two very different subjects—the history of the foundation and progress of the British Museum, with especial reference to the department of natural history, and of ornithology in particular, and that very fascinating theme, geographical distribution. Though many of us were aware that the nucleus of the present British Museum began with the acquisition of the collection of Sir Hans Sloane, probably few know that this was purchased, with Montagu House designed to hold the collection, by means of a lottery. Yet such is the case.

After the address came the appointment of Presidents of Sections, and in the afternoon the real work of the Congress began.

Of the many papers read, a large proportion were necessarily of a very technical character, yet every section was well attended.

It is curious that only two papers were read which dealt with museums in regard to ornithology, and of these only one was professedly devoted to this subject. This was submitted by Mr. Frank B. Chapman, of the American Museum of Natural History, New York. He dealt with the question, "What constitutes a museum collection of birds?" Helpful and suggestive, it was rendered yet more useful by a series of beautiful lantern slides, and these, it is to be hoped, will form the illustrations to his paper. In the course of his remarks, he referred in terms of the highest praise to our own Museum of Natural History, which, he said, he regarded as the most perfect institution of its kind which he had ever seen.

Besides this, Mr. Chapman read two other papers—"A Contribution to the Life History of the American Flamingo" and "A Contribution to the Life History of the Brown Pelican." These two essays were of quite remarkable interest, and were illustrated by a superb collection of slides. They were, indeed, models of how "bird-watching," as some would have us call observation of this kind, should be done. The papers of Dr. Willson and Mr. Bruce on the results of their ornithological work in the Antarctic formed no less striking proofs of what can be done in the field by men who are trained to observe. The testimony to the strenuousness of the struggle for existence, indeed, has never been more graphically demonstrated than by Dr. Willson on this occasion.

Dr. Dwight (New York) contributed two extremely interesting papers on peculiarly difficult subjects:—"The Significance of Sequence in Moults and Plumages," and "Some Phases of Wear in Feathers." These are subjects which promise to yield a good harvest to the patient investigator, yet in this country they have received but scant attention, though some of our commonest native birds illustrate many of the more remarkable exceptions to the general rule of moults and the phases of immature dress. How many, for example, of our field ornithologists could describe the phases of plumage which the gannet passes through before attaining maturity?

Mr. J. L. Bonhote gave an admirable summary of the experiments he is conducting on the hybridization of ducks, illustrated by lantern slides. Though too complex for the majority of his hearers to follow, when presented with the facts in the necessarily rapid survey he was compelled to give, yet all agreed that these experiments had yielded very substantial results.

Bird protection very properly came in for its share of attention. This very difficult problem was discussed from many points of view. Mr. Digby Piggott gave a lucid summary of the ridiculous anomalies to be found in our present system of legislation, while Mr. Frank Lemon gave an equally helpful and thoughtful paper on the "Rationale of Bird Protection," which gave rise to considerable discussion.

For the first time, we believe, in the history of the Ornithological Society, "aviculture" found a place in its deliberations, Mr. D. Seth-Smith reading a most useful and instructive paper on "The Importance of Aviculture as an Aid to the Study of Ornithology." This was undoubtedly a valuable contribution to a most neglected subject.

But, perhaps, the great feature of the Congress was the lecture by the Hon. Walter Rothschild on "Extinct and Vanishing Birds." This will long be remembered as a masterly exposition of a very difficult subject, illustrated in a manner absolutely unique in the annals of ornithology.

To hear the lecture the whole Congress was conveyed, by the generosity of Mr. Rothschild, by special train to his museum at Tring Park. Here, in a large hall, were gathered together a vast collection of birds, either already extinct or fast becoming so, and these were inspected after the lecture.

Among the more remarkable of these exhibits were skeletons of the Moa and Æpyornis, as well as eggs of these birds, and stuffed examples of the rare Labrador Duck, Black Emu of Kangaroo Island, and the starling of Reunion (Fregilupus). Of the Dwarf or Black Emu only two skins are known. The number of birds in danger of extermination is unfortunately a large one, and this was painfully evident from the number of specimens displayed here. To make this collection more perfect Mr. Rothschild enlisted the services of some of our best known bird artists to prepare coloured restorations of some of the more striking forms which he was otherwise unable to illustrate. Among these we must specially refer to a really wonderful restoration, in oils, of the small Dinornis by Mr. G. E. Lodge. Mr. Frohawk contributed three striking pictures to this number—a Moa 15 feet high, the Giant Rail *Leguatia*, and the Solitaire.

But the end of the Congress is not yet. Though officially over on Saturday, June 17th there remain at the time of writing three very important items to fulfil—the excursion to Woburn Abbey to see the collection of wild animals kept by his Grace the Duke of Bedford, the visit to Cambridge, and the trip to Bridlington to visit the breeding cliffs of the guillemots. With this last, the most successful of the Ornithological Congresses yet held will come to a close.

XUM

Seaweeds:

A Holiday Paper for Field Botanists.

By DAVID W. BEVAN, Scarborough F.N. Society.

MOST botanists will, during their summer holidays, stick to the cliff and sand dune to seek *maritime*, not *marine*, plants. But it seems a pity that the latter should receive such scant attention. The beauty of many of the sea weeds is so exquisite, the way of life of others so interesting, that the field botanist cannot afford to miss them, and this is specially the case if he possesses a microscope. A shore that possesses a rocky reef, laid bare twice daily by the ebbing tide, is the best collecting ground, and as this article is penned at Scarborough it may not be out of place to mention that it is an ideal place in this respect. Arrived on the scene with a tin canister or two—a bottle of sea-water is also needed, but should not be carried on the slippery rocks—we proceed to take "snippings" of everything we come across.

It is noticed at the outset that the seaweeds tend to be clannish. The green ones favour, on the whole, the part towards high-tide mark, and the brown the part between tide marks. A good many red flourish there, too, but as a rule their red is a very poor red—nearly black or faded yellow. It is mostly in the deepest pools, and out in those deeper reaches that are never laid bare by the tide that those splendid crimsons and rosy reds occur that are the typical colours of the red seaweeds. To get these last we must wait till a storm tears them from their moorings and casts them on the shore.

The brown seaweeds are the giants of the shore, and claim our attention very much, for they are slippery customers. Growing on the margins of all the pools are the Wracks (*Fucus*), all of which branch, by repeated division into two (dichotomy), much like the flowering stalk of the Stitchwort, but always in the same plane, so that if we spread a plant out on the sand it forms a perfectly flat, fan-shaped frond. The Bladder Wrack (*F. vesiculosus*) has paired bladders in the frond (Fig. 1). The Serrated Wrack (*F. serratus*)

Fig. 1.

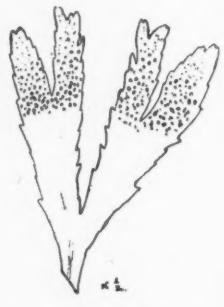


Fig. 2.

is without bladders, and has, as its name indicates, a saw-like edge to the frond (Fig. 2). The Knotted Wrack (*F. nodosus*) is "all stalk," with big bladders in the stalk like a string of oval beads, and its frond has no flat, leafy expansion or blade. It does not divide dichotomously, and in other respects, stated further on it differs from the typical Fucus (Fig. 3). This plant seems particularly happy in tidal river mouths where the water is only slightly salt. *F. canaliculatus* has channelled fronds, and grows only three to six inches high.

Then there is the fine, bushy Sea Oak (*Halidrys siliquosa*) in great plenty in the deeper pools, known by its pod-like bladders, which are seen, on being split by a penknife, to contain several storeys (Fig. 4). Lastly,

Fig. 3.

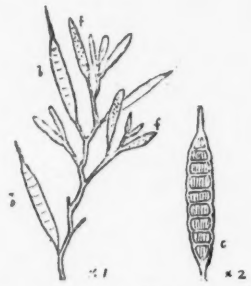


Fig. 4.

not to stay among the Wracks too long, there is the delightful Sea-thong (*Himanthalia lorea*), growing at dead low-tide mark. There they grow in scores—well worth a snap-shot—like little brown mushrooms when young, but in their second year they put out a long strap-shaped dichotomous frond from two to three feet long, which is the reproductive part (Fig. 5).

Here at low water we see the Tangles (*Laminaria digitata*), a stout stalk which may reach three feet

Fig. 5.

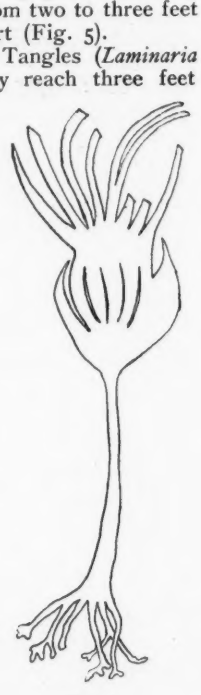


Fig. 6.

long or more, bearing a broad flat mass of ribbons on the top. This upper frond is shed in spring and a new one grows there and splits into ribbons in due course. One sometimes finds both old and new fronds on the one stalk (Fig. 6).

The most interesting thing about the Fucoids is their reproductive arrangements. Everyone has noticed the swollen ends of the fronds of the Wracks beset with

tiny holes. These holes are the conceptacles, inside which the eggs and sperm are formed. Though most plentiful in early spring they are to be found all the year round. The fronds with bright orange tips are male and the dull brown ones are female.

Now, on a bright day when the tide is out we can easily find tiny drops of brown or orange jelly which have issued from the conceptacles. The one kind contains the ova, the other the male elements, and it is now our business to bring these together under the microscope. It is best to break off the tips of the fertile fronds, keeping the sexes separate, and lay them on two *dry* saucers, placing them in a good draught for some hours. A plentiful supply of mucilage will appear, and if a little of the brown is now added to a single drop of sea-water on a glass slip and examined with a low power, a very pretty sight presents itself. Numerous bags (oogonia) of ova, eight in a bag, are

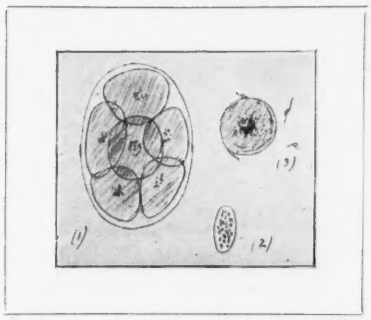


Fig. 7.

FUCUS. (1.) Oogonium (egg-case). 6 of the 8 ova are visible.
(2.) Antheridium with spermatozoa.
(3.) A discharged egg cell with 4 spermatozoa attacking it.

lying about (Fig. 7). But the rising tide (represented by the drop of sea-water), begins to act on them; the wall of the oogonium disappears, and out float eight beautiful round brown eggs.

When the orange-coloured jelly is similarly treated —a higher power is desirable—we see large numbers of much smaller cells, which in like manner discharge their contents. But instead of ova we see immense numbers of minute male cells, which no sooner find themselves in the sea (a drop of water is an ocean to them) than they put out two cilia and begin to swim hurriedly, and *apparently* aimlessly, about. We say *apparently*, for if one of these spermatozoa can succeed in reaching and penetrating a female (egg) cell it will have fulfilled its destiny. Then, and not till then, can the egg develop to form a new Wrack.

When, therefore, we add a few ova to a drop of water containing sperm, immediately the male cells cease their aimless wanderings and hasten to the side of the female cell. But why? They have no eyes to see the beautiful roundness of her form—no senses that we know anything about. They are only tiny bits of protoplasm, and yet there is in them a *something*, a sentiment—call it chemotaxis or what you will—we, out for a holiday, prefer to regard it as the very germ and essence of the tender passion. Scores, hundreds, of the swimming cells surround the female body, which whirls round and round on its axis, not exactly from giddiness, but from the force of the attentions it receives. At last one of the male bodies penetrates it, fertilization is effected, and the romance is at an end.

If a number of conceptacles of both kinds, with the mucilage on them, are washed in a basin of water and the contents examined daily, we may trace the first stages in the germination of the fertilized egg cells—and, of course, *draw* them.

Several of the other brown seaweeds present the same features—with variations. In the Sea Thongs, the whole thong borne by the mushroom-like frond is beset with conceptacles. Then the number of eggs in a bag varies in different plants. The Knotted Wrack has only four ova in a group, the Channelled Wrack two. These differences are now considered of sufficient importance to warrant the establishment of two new genera. *F. nodosus*, which we have already seen to differ a good deal from the other wracks, is now *Ascophyllum nodosum;* and the other is *Pelvetia canaliculata.*

A fair average specimen of *F. serratus*, selected by chance, had 18 fertile branches that had already discharged ova, and 16 others not fully ripe. Of the 18 a chance one had over 300 conceptacle pores on one side, and presumably the same number on the other side. Now, in the course of a single season, the egg-cases, discharged as fast as they ripen, may be put, at a very moderate estimate indeed, at a dozen from a single conceptacle. Each oogonium contains eight ova. Total number of ova, without considering the 16 immature branches, considerably over half a million. The extraordinary plenty of the brown seaweeds ceases to be a matter of surprise. The sea near the shore must sometimes teem with ova. They settle down everywhere, and at once attach themselves to the rock and begin to develop into new plants.

Several other brown varieties will be met with which space forbids us to describe. Two very common and very handsome relations of the Giant Tangles, bearing only a single ribbon, and very much smaller in size (*Laminaria saccharina* and *L. bulbosa*) are pretty sure to turn up. Then there are several smaller plants, much easier to dry and mount than those we have mentioned, though perhaps less interesting in themselves.

Here we take leave of the brown seaweeds unless we choose to emulate the "tripper," who carries home with him as a trophy a trailing handful of wrack—a silent monitor, in consequence of its saltness, to warn him of the coming storm. In the next article we shall deal with the "Red Seaweeds," and in it we shall have something to say about collecting and preserving.

The Gegenschein and Zodiacal Light.

SIRS,—It would be interesting to know whether any special observations have been made, or can be made, on the above-named little-understood phenomena during a total eclipse of the Sun.

Two theories have been suggested regarding the origin of the Gegenschein. One is that it is the reflection of the Sun's light from meteorites at a distance, which being opposite the Sun are at "full moon." The other is that it is the forms of the Sun's rays reflected in our atmosphere. Now if the former theory be correct, a total eclipse should not have any material effect upon the appearance, but if the latter, there should be a distinct diminution of light at the moment of eclipse.

So too with the Zodiacal Light. Some consider it as an atmospheric phenomena, others as a solar adjunct. And much might be done to elucidate this point if careful observations were made during the occurrence of a total eclipse.

Yours truly,
P. R. R.

XUM

Acetylene as an Explosive.

SOME interesting researches have recently been made by M. Gréhant on explosive mixtures of air and acetylene and corresponding mixtures of air and oil gas. The tests were made in tubes of 50 cubic centimetres for the acetylene and of 90 cubic centimetres for the oil gas. The mixtures were exploded by an electrically-heated incandescent wire. The following are the results obtained :—

Volume of gas.	Volume of air.	Percentage of gas.	With acetylene.	With Oil-gas.
1	1	50·0	Burns with smoky flame.	Does not burn.
1	2	33·3	Ditto.	Ditto.
1	3	25·0	Detonates with deposition of carbon.	Feeble detonation.
1	4	20·0	Stronger detonation without deposition.	Stronger detonation.
1	5	16·7	Strong detonation.	Strong detonation.
1	6	14·3	Ditto.	Ditto.
1	7	12·5	Very strong detonation	Less strong.
1	8	11·1	Ditto.	Ditto.
1	9	10·0	Ditto.	Feeble detonation.
1	10	9·9	Strong detonation.	Ditto.
1	11	8·3	Ditto.	Very feeble detonation.
1	12	7·7	Ditto.	Does not ignite.
1	13	7·1	Less strong.	Ditto.
1	14	6·7	Ditto.	Ditto.
1	15	6·3	Feeble detonation.	Ditto.
1	19	5·0	Very feeble detonation.	Ditto.
1	20	4·8	Burns without detonation.	Ditto.

These results show that the detonations obtained with acetylene are more violent than those with oil-gas, but that, nevertheless, the acetylene is less dangerous than oil-gas.

CORRESPONDENCE.

The Visibility of Planets in Daylight.

SIRS,—Some of your readers may be interested in knowing that it is quite possible for them to see the planet Venus in broad daylight, with the naked eye, and no apparatus of any sort. I have for the last six months or so constantly seen her shining high up in the heavens in the blazing light of a South African sun at mid-day. It merely requires one to take a rough measurement on a stick, and one evening, about sunset, to see how far she is from the sun, and the direction. You can then, next day, discover her without opera glasses or any other help. Of course, at first it is extremely hard to find the planet, but after a little practice the eye picks it up easily. I have found it on a cloudless sunny day while riding along the veld. I have also succeeded in seeing Jupiter in full sunlight in the same way, and lately I have, owing to this practice, managed to find Sirius and Canopus with the sun some way above the horizon, and shining brightly. It is not only owing to the clear atmosphere of this country, as I have found Venus on a somewhat hazy day, certainly far less clear than one often gets it in England. It would be interesting also to know if any of your readers have seen the waning moon within 40 hours or so of new moon. By careful search I have succeeded in seeing it about that time from new moon, in mid-day in a cloudless sky, nearly overhead. As she is so exceedingly thin and close to the sun, you can imagine how hard it is to find her with the naked eye. Those novelists or poets who have been decried by the critics for making the crescent moon shine overhead, will now be able to refer to my statement in verification of their words.

I am, yours truly,

T. B. BLATHWAYT.

Kokstad, E. Griqualand, S. Africa,
April 29, 1905.

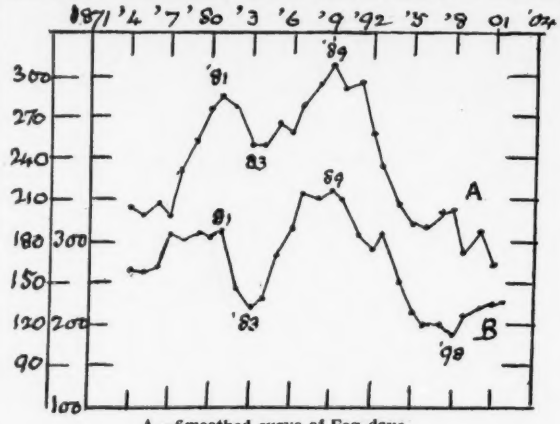
[As regards Venus, it is well known that this planet "is so brilliant that there is no real difficulty in seeing her with the naked eye in full sunshine, or indeed at high noon."—*Maunder, "Astronomy without a Telescope,"* p. 147.—ED.]

London Fog and Frost.

SIRS,—In a paper lately read before the Royal Meteorological Society, the author, Mr. F. J. Brodie, gave some useful tabulated data of fog observed in London during twenty years, and came to the sanguine conclusion that the great decrease of fog in recent years points to a victory over the fiend by smoke abatement in various ways.

Without affirming that there is no improvement from this cause, or questioning the obvious wisdom of efforts to do away with smoke, I cannot but think that climatic influences are the chief factor in the improvement observed.

If we combine Mr. Brodie's figures for autumn and winter, and smoothe the series by sums of five (*i.e.*, adding the first five, then the second to the sixth, and so on), we get the curve A; and doing the same with the totals of frost days in winter seasons at Greenwich, we have the curve B.



A.—Smoothed curve of Fog-days.
B.— ,, ,, Frost-days.

This is obviously a rough comparison, and remembering also the uncertainty attaching to fog determinations, we should not look for very exact correspondence in these curves; but there is general agreement, and, in particular, while the fog curve shows a long general decline from about 1889, the frost curve does the same.

If we get up again to the 1889 level of frost, will the fog curve fall short of *its* level for that year? That remains to be seen; and before giving rein to the triumphant spirit, we had better first see, perhaps!

I am yours, &c.,

ALEX. B. MACDOWALL.

NOTES.

ASTRONOMICAL.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

The Canals of Mars Photographed.

A SHORT time back the important news was telegraphed from Lowell Observatory that the much-criticised markings on the Martian surface had been successfully photographed by Mr. Lampland, and the last circular from the observatory not only confirms this, but contains an actual print from the negative showing the markings.

Many attempts have been made at the Lowell Observatory at Flagstaff, Arizona, to photograph the canals of Mars, commencing with the success of Mr. Douglass in 1901, when, by

using a Wallace screen, he secured a good picture of the Mare Acidalium. Encouraging as the result was, there were no signs of any canal markings. The two chief difficulties were the variation of the atmospheric tremors, and the insufficient sensitiveness of the photographic plates. The endeavours to get rid of these errors resulted in the ordering of a film camera wherewith a succession of pictures could be rapidly taken behind a Wallace screen; and with this arrangement Mr. Lampland has got his interesting results. A most important item, however, has been the suitable cutting down of the aperture of the photographic telescope to suit the particular state of atmosphere at the time of observation.

From the many plates secured, the one taken on May 11 was selected for the reproduction sent with the circular. Side by side with the print is placed a photograph of a drawing by Professor Lowell, made before the camera was placed in position, and this serves the double purpose of showing the confirmation by the photograph of the objectivity of the visual observation, and at the same time of serving as a chart to it.

The print is enlarged 1·8 times from the original negative; and not only are the canals easily discernible, but it is evident that they are *continuous* lines, and not syntheses of other markings, as has been suggested by various writers.

An additional note by Mr. Lampland states that the photographs were obtained with the 24-inch Clark refractor of 386 inches focal length. The camera carries a negative enlarging lens, the equivalent focal length of the combination being 148 ft. The camera carries a plate holder for 3¼ × 4¼ plates, movable perpendicularly to the optical axis, thus permitting a dozen or more exposures on the planet, for the focal length given, to be made on the same plate.

A colour screen is placed immediately in front of the plate, separated by a small space to minimise the effect of small particles of dust or other extraneous matter. Cramer's isochromatic plates were used, this make being chosen on account of the fact that one of the maxima of the curve of sensitiveness of the plate coincides almost exactly with the vertex of the colour curve of the large objective. The best results have been obtained with the 24-inch stopped down to 9 or 12 inches, and the exposures were usually about eight seconds each with the 12-inch aperture.

Spectroscopic Observations of Mercury during Solar Eclipse.

Dr. G. Johnstone Stoney draws attention to the opportunity which will be afforded during the approaching total solar eclipse on August 30 of obtaining important observations of the planet Mercury. At that time Mercury will be very close to the line joining the Earth and the Sun; its centre is 2° 54′ South, and 2° 54′ preceding the Sun, so that the distance is only about 4° 6′, and the illuminated portion of the planet's disc will be seen as a very fine crescent. If the planet possesses any appreciable atmosphere, the horns of this crescent will be prolonged by the effects of atmospheric refraction, and micrometric measurements of the degree of such elongation would furnish material for calculating the extent of the planetary atmosphere. For such an observation a telescope magnifying about 200 diameters would be desirable. Further important and interesting determinations may be made by treating the thin crescent as a slit, and viewing it through a spectroscope, as then the exact constitution of the atmosphere surrounding the planet might be ascertained.

Photographic Studies of the Planet Mars.

Quite recently a series of successful photographs of the planet Mars have been obtained under the direction of Professor W. H. Pickering at the Harvard College Observatory. In the spring of the present year the 11-inch Draper telescope was fitted with an enlarging lens, and it was found possible to obtain original negatives showing the disc of the planet on a scale of about 2″·5 to the millimeter.

The first photograph was obtained on March 31, and others were secured on April 1, 2, 8, 15, 16, 18, 23, 25, 27, 30. The first photograph showed clouds at both the limb and terminator, but no definite evidence of actual polar caps was visible on the photographs until April 23, when a large light area was clearly visible at the south pole. It did not appear dark enough for snow, but presented more the appearance of an extensive cloudy region. It remained visible on all the photographs since that date, although its intensity and size diminished somewhat. A minute light area appeared near the north pole of the planet on April 15, but was seen only with difficulty.

On the night of April 30, visual observations were made with the 24-inch reflector. The southern polar cap was clearly visible, extending far to the north in longitude 340°, but its intensity was only slight, little exceeding that of the limb in other regions. It is considered probable that when the Martian clouds disperse snow may be found lying in their places.

Considering briefly the aspect of the planet at these times, we notice that the heliocentric co-longitudes on April 15 and 23 were 216° and 220° respectively. These positions would correspond on the earth to August 3 and 7, or to near the end of the winter of the southern hemisphere. Snow seldom comes earlier on Mars. It will be very interesting to observe if the brown tint described by Lowell as characteristic of the Mare Erythræum will become changed to its normal colour. This change of colour with the seasons may yet afford the best proof of the existence of vegetation upon the planet Mars.

Ephemeris for Observations of Comet 1904 I.

This Comet will be somewhat near the Sun, and should be looked for a little before sunrise, in the constellation Lynx, above Cancer.

1905.	R.A.			Declination.		Relative Brightness.
	H.	M.	S.	°	′	
Aug. 2	8	33	15	+ 43	11·5	0·028
4		34	15	43	4·7	
6		35	14	42	58·1	0·028
8		36	12	42	51·8	
10		37	9	42	45·7	0·028
12		38	5	42	39·9	
14		39	0	42	34·3	0·027
16		39	54	42	29·0	
18		40	48	42	23·9	0·027
20		41	40	42	19·1	
22		42	31	42	14·6	0·027
24		43	21	42	10·3	
26		44	9	42	6·3	0·026
28		44	56	42	2·5	
30		45	42	41	59·0	0·026
Sept. 1		46	26	41	55·7	
3	8	47	9	+ 41	52·7	0·026

CHEMICAL.

By C. A. MITCHELL, B.A. (Oxon.), F.I.C.

The Flashing of Arsenic Crystals.

ARSENIOUS oxide, the ordinary *white arsenic* of commerce, forms two distinct modifications, differing from each other in specific gravity, melting point, and other physical properties. The vitreous modification is semi-transparent, but on exposure to the air gradually becomes opaque and of a yellowish tinge as it changes into the other variety. As far back as 1835 it was found by Rose that when the vitreous modification was dissolved in boiling hydrochloric acid the excess of uncombined arsenic separated out in minute crystalline octahedra from the solution on cooling, and that on shaking the contents of the flask in the dark a succession of brilliant flashes was emitted. The generally accepted explanation of this very beautiful phenomenon is that at the moment when the crystals separate the vitreous modification is suddenly transformed into the crystalline variety, the change being accompanied by a liberation of energy expressed in the form of light. It has recently been shown, however, by M. D. Gernez (*Comptes Rendus*, May, 1905), that this explanation is incorrect. He finds that if the flask be kept absolutely still the formation of

the crystals is unattended by any emission of light whatever, but that if the flask be shaken the crystals are ruptured by contact with the glass or each other and then produce the flash. The property is by no means a fugitive one, and the dry crystals will yield sparks months afterwards if rubbed with a glass rod. Moreover, contrary to the statements of the text books, the emission of light is produced as readily by crystals formed from the opaque variety of oxide as by those from the vitreous modification. The phenomenon is thus another instance of *triboluminescence*, the name given to the property possessed by many crystalline substances of emitting light when struck or rubbed. Herr Tchugaeff has shown that very many bodies possess the same power. Thus, of 400 substances examined by him, 121 were found to emit light, the alkaloids, as a class, being particularly active, but only 6 out of 110 inorganic bodies showed the phenomenon. The colour of the light varied with the different substances, and its intensity could be classified according to an arbitrary scale in which uranium nitrate was taken as typical of the first class, tartaric acid of the second, and ammonium oxalate of the third. The nature of the light emitted by arsenious oxide has also been studied by M. Guinchant, who finds that it has a continuous spectrum in the visible part of which the green and yellow rays predominate, though red rays are also present. The light does not affect an electroscope, but has a strong action upon a photographic plate, and is apparently identical in character with the light emitted by solid bodies in a state of incandescence.

The Physiolo gicalAction of Air in Crowded Rooms.

It is a commonly accepted belief that the unpleasant effects produced on the human system by the air in overcrowded rooms is due to volatile products given off by the skin and lungs; but experiments made by Dr. Paul of the Breslau Hygienic Institute appear to indicate that the main cause is the retention of heat by the body. Under normal conditions heat is lost by conduction, radiation, and evaporation of moisture, as well as during respiration. The loss of heat by conduction is to a large extent prevented in crowded rooms, in which the air is usually of a relatively high temperature, and contains a high proportion of moisture, while the loss by radiation is very incomplete when the body is surrounded by others at about the same temperature. In Dr. Paul's experiments it was found that headache and all the other unpleasant symptoms could be entirely prevented by regulation of the heat, even when the air was saturated with respiration products, and contained as much as 15 per cent. of carbon dioxide; whereas without this regulation of temperature they appeared even when absolutely pure air was breathed. The retention of heat could be demonstrated objectively by the rise in temperature of the skin.

The Action of Hydrogen Peroxide on a Photographic Plate in the Dark.

Systematic experiments have been made by Dr. C. Otsuki, of Tokio, to determine the nature of the changes produced by hydrogen peroxide acting upon a photographic plate in the dark, and to test the assertion that the action of the reagent could penetrate through a sheet of metal (see "KNOWLEDGE & SCIENTIFIC NEWS," this Vol., p. 100). It was found that gelatin, celluloid, certain gums, and Canada balsam were permeable, but that paraffin, fish membrane, ebonite, glass, and metals were not. In the experiments with metals the greatest care was taken to insure the absence of minute holes, the thin films being examined under the microscope before and after the exposure. The metals used were zinc, copper, tin, an alloy of gold, silver, and platinum, brass, and aluminium in thin films ranging in thickness from about one thousandth to one tenth of a thousandth of an inch. Out of 47 experiments action upon the plate was only observed three times, and in each case minute holes were found to have been formed by the corrosive action of the hydrogen peroxide vapour upon the metal. The temperature had a considerable influence upon the reaction between the gelatin silver bromide and the hydrogen peroxide, lighter or darker zones in the image (Graetz's "border effect") being produced by small variations in different parts of the plate or between the plate and surrounding bodies. In some cases the borders were lighter than the centre, while in others the reverse was the case. It is not improbable that this may also account for the curious border produced by the action of wood upon a photographic plate in the present writer's experiment ("KNOWLEDGE & SCIENTIFIC NEWS," this Vol., p. 120), assuming that hydrogen peroxide was the active agent in this case. Professor Otsuki concludes that the action of hydrogen peroxide upon the silver bromide is to convert it into a lower bromide which can be reduced readily by the developing solution. It cannot be regarded as due to radiation.

GEOLOGICAL.

By EDWARD A. MARTIN, F.G.S.

Erosion in Freshwater Bay.

THE possibility of the sea breaking through what remain of the low-lying cliffs in Freshwater Bay and forming a junction with the waters of the sluggish Yare gives rise to many interesting geological considerations. It is not a little remarkable that a river should take its rise in such close proximity to the sea as does the Yare, and for an explanation we must look back to a geological time when the sea was much farther away to the south than it now is. Even within the historical period great changes have taken place in connection with the coast of the Isle of Wight, and the extent of the island has dwindled to its present dimensions. When, too, we look at the width of the valley of the Yare, one is apt to wonder how such a slow-flowing stream could ever have had the necessary force to carve a wide valley. The river is now, however, in its old age. Probably it would long since have been silted up, had there been a sufficient watershed to have ensured a plentiful supply of sedimentary material. Now, there is a chance of a new lease of life being given to it, if the dreaded possibility happens, and the sea leaps the barrier at Freshwater Bay, to join hands with the river itself. But there is another possibility of a different nature. Would it be worth while draining the upper reaches of the Yare? It would not be a difficult matter to prevent tidal action from having any influence beyond the town of Yarmouth; then much of what is almost stagnant water might be drained, and valuable land in Freshwater Bay saved from destruction.

The Tarns of Ticino.

In pursuance of Prof. E. J. Garwood's studies into the action of ice, an interesting paper has been read by him before the Geological Society, in which he deals with the formation of the Tarns of the Canton Ticino. Excavation by ice-action, so far as these lakes are concerned, finds no support in the paper in question. In some cases the ice must have invaded the district from the outside, and from several directions at once. The lakes appear for the most part to be due to structural peculiarities of the district, lying often in lines of junction, or indicating lines of weakness; while at the same time the presence of numerous springs gives rise to a belief that solution may have formed a not unimportant part in their formation.

Glacial (?) Geology.

Sir Henry Howorth is excellent company, whether in person or in his writings, and those who have enjoyed his humour as a *raconteur* will almost feel that he is playing an enormous joke at the expense of the geological world in launching his thousand-page work on "Ice and Water." Sir Henry is following up with his usual courage his contentions in regard to the generally-accepted theories of ice-action and water-action, and those who have read and enjoyed "The Glacial Nightmare" and "The Mammoth and the Flood" will be prepared for this further exposition of his views. Almost as one crying alone in the wilderness, his works are full of excellent reading, and crowded with data, brought together with infinite patience, and if one is apt to develop too much into an extremist in any particular school of geology, one finds an agreeable corrective here.

Uintacrinus in the Croydon Chalk.

Dr. G. J. Hinde has found a very close resemblance to some of the higher zones of the chalk of the coast near Margate in the chalk of the tract between Russell Hill and Beddington, in Surrey. Hitherto the chalk hereabouts had been thought to belong to the zone of *Micraster cor-anguinum*, although when last year the third volume of the "Cretaceous Rocks of Great Britain" was published by the Geological Survey, it was anticipated that the zone of *Marsupites* was present. Doubts have now been set at rest by the discovery by Dr. Hinde of some test-plates of free-swimming crinoid *Marsupites*, with *Echinocorys scutatus*; and at the same time he discovered some smaller inconspicuous test-plates, which, on close examination, were found to belong to the unstalked free-swimming crinoid known now as *Uintacrinus*. These show the existence, near the place where the chalk disappears beneath the tertiaries, to re-appear on the north of London, of the lower portion of the *Marsupites*-zone, called by Dr. Rowe the "Band of Uintacrinus." The fossils found by Dr. Rowe in this band in coast-sections near Margate agree almost identically with those found by Dr. Hinde near Beddington.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The Scent of Sitting Birds.

MR. TEGETMEIER, at the last meeting of the British Ornithologists' Club, made some interesting observations on the scentless nature of birds when sitting on their eggs. He contended that the physiological explanation of this was well known, and that the "vicarious secretions" causing the scent were retained within the body in sitting birds, and passed into the cloaca, to be eventually voided with the fæces. The odour of the fæces dropped by a sitting bird was, he said, totally different from that passed at other times, and their particularly offensive smell was caused by these secretions.

We venture to think that this explanation will not stand the test of investigation. Birds are unique in the glandless nature of their skin, even sweat glands being absent. Whatever smell escapes is probably exuded by the feet; hence the care taken by many birds to fly straight off from the nest, and so prevent the tell-tale traces, which would otherwise be left, of the whereabouts of their eggs. The unusual offensiveness of the fæces may be explained by their long retention in the cloaca.

The Eggs of the Knot.

Dr. Bianchi, of the St. Petersburg Museum, brought with him, on his recent visit to London, a collection of twelve eggs of the Knot (*Tringa canutus*), and a few nestlings, and these he exhibited at the last meeting of the British Ornithologists' Club.

The nestlings of this bird were discovered by Colonel Fielden when in the Arctic expedition of 1876; but the eggs remained unknown till discovered by the late Dr. Walters on an expedition to the Taimyr Peninsula in 1901. To allay all doubt as to the identity of these eggs the parent birds were also taken. The eggs are remarkable for the great variability which they show in size, form, and colour. The ground-colour ranged from "pale clay" to pale yellowish white, and pale green. The markings took the form of dirty-brown and violet-grey spots, tending to cluster at the blunt end of the egg, and varying much in size.

Dr. Walters was the medical attendant and ornithologist of the expedition, and died before it returned, at Kotelny Island, December 21, 1902.

Nesting of the Scoter in Ireland.

The *Field*, July 15, contains a most interesting account by Major Trevelyan of his discovery of the breeding of the Common Scoter (*Œdemia nigra*) "on one of the loughs in Ireland" during this summer. He had the good fortune to discover the female sitting on a nest of eight eggs in June last. This was placed under a small bush on an island. On July 1, he found her with five young ones swimming about in the lough. Tufted ducks were breeding here in some numbers, and in several cases it would appear that more than one female was laying in the same nest, since as many as twenty-one eggs were found in one case and nineteen in another! Two other nests contained sixteen and eighteen eggs respectively. Gulls seem to levy a heavy toll on the young of these birds, as well as on the eggs.

The exact locality of this new breeding-ground is very wisely withheld.

Waxwings in Berkshire.

In the Bulletin of the last meeting of the British Ornithologists' Club, Major F. W. Proctor records the occurrence of a pair of Waxwings (*Ampelis garrulus*) at Maidenhead Thicket on April 11. They were, we learn, unmolested, but whether they remained to breed has so far not been ascertained.

Marsh-Warbler Nesting in East Kent.

Mr. Collingwood Ingram at the meeting above referred to exhibited an egg of the Marsh-Warbler (*Aerocephalus palustris*) taken from a nest of five. The remaining four eggs were left and hatched out. This is believed to be the first authentic instance of the breeding of this species in Kent. The nest was placed in on the shoots of a young ash-tree about three feet from the ground. It was composed of dried grass-stalks and lined with horse-hair and cocoa-nut fibre, the latter procured from a neighbouring hop-garden.

The Western Black-Eared Chat at Hove.

An example of the Black-eared Chat (*Saxicola albicollis caterinæ*) was killed at Hove on May 22, 1905. This is the second recorded instance of this bird in Sussex; the first example having been killed three years ago. Both cases were reported to the British Ornithologists' Union by Mr. R. Butterfield, who saw each bird in the flesh.

PHYSICAL.

By ALFRED W. PORTER, B.Sc.

A Scientific Essential.

AND above everything the scientist must foresee. Carlyle wrote somewhere to this effect: "The fact alone matters; *John Sansterre passed this place;* there is a reality for which I would give all the theories of the world!" Carlyle was a compatriot of Bacon, but Bacon would not have said that. That is the language of the historian. The physicist would say rather: John Sansterre passed this way! That is nothing to me, since he will not pass this way again.

Poincaré, La Science et l'hypothèse.

The Alpha Stream.

Professor Rutherford is making an extended investigation into the properties of the Alpha stream of particles emitted in many of the stages of disintegration of radium. A preliminary account appears in the *Philosophical Magazine* for July. The main object of the experiments is to obtain a more accurate measure of the mass of each of these particles, and thence to decide whether or not they are identical with helium. This better value has not yet been obtained, but many facts of importance have turned up in the course of the preliminary observations.

Previous measurements have been made on the particles shot out from radium. But it is now known that radium in a state of radio-active equilibrium is a very complex substance; and that the particles shot out at different stages do not leave with the same velocity. The improvement now introduced is to use one of the disintegration products alone, viz., Radium C. Radium A (the product of the disintegration of the emanation) is deposited on a highly negatively charged wire. This quickly breaks up successively into Radium B and C, and the Alpha particles then shot out are taken as arising from C because B does not emit any. This wire is then placed behind a slit, and the stream that passes the slit falls on a photographic plate, slit and plate being placed a few centimetres apart. The whole is placed in a transverse magnetic field in a vacuum, and the field reversed every ten minutes for about an hour. On development the plate shows

two narrow bands, at greatest 4·7 mms. apart, and from this measurement the curvature of the stream due to the field was determined. From this the value of mass × by velocity ÷ charge of each particle can be calculated. The values obtained are much more definite than previous ones. To complete the calculation of the mass, it is necessary to deflect the stream by an electrical field as well. This has not yet been done, owing to the difficulty of quickly obtaining a sufficiently high vacuum.

If thin aluminium sheets are interposed the velocity of the stream is reduced; and experiment shows that the photographic action ceases when the velocity is still 64 per cent. of its initial value—*i.e.*, when the velocity is about one-twentieth that of light. The ionising and phosphorescent action also cease at this velocity. This is a surprising result, for the particle still possesses nearly 40 per cent. of its initial energy at this stage.

The similarity in respect to the three phenomena can be most simply explained by supposing that photographic action and phosphorence are essentially due to ionisation.

It is most interesting to observe that the actual velocity of emission is on the average only about 30 per cent. greater than this critical velocity. The Alpha stream would not have been detected if its velocity had been much less than it is. Professor Rutherford points out that disintegration may be taking place in other substances and be practically undetectable, because this lower limit of ionising velocity is not attained by the particles emitted. This remark may also apply to Radium B, which is a so-called *rayless* product; and we further suggest that a similar remark may apply also to the Beta particles, and that such slow velocity negative particles may therefore be present *in each of the stages of disintegration*. This supposition would remove the difficulty which some feel in conceiving of the production of a positive particle without a negative one being simultaneously generated.

ZOOLOGICAL.

By R. LYDEKKER.

The Late Dr. W. T. Blanford.

ZOOLOGISTS and geologists throughout the world will hear with unfeigned regret of the death of Dr. William Thomas Blanford, C.I.E., F.R.S., which took place at his residence in Campden Hill, London, on June 23, after a brief illness, in his 73rd year. Dr. Blanford was on the staff of the Geological Survey of India from 1855 till 1882, retiring with the rank of Senior Deputy Superintendent. He was a gold medallist of the Royal Society and a Wollaston Medallist of the Geological Society, and had been President of the latter body as well as of the Asiatic Society of Bengal. During his Indian service he was attached as naturalist to the Abyssinian Expedition under Lord Napier, and later to the Persian Boundary Commission under Sir F. Goldsmid. Of late years he had devoted himself largely to the study of the geographical distribution of animals and of the changes in the configuration of the earth's surface which have had so much to do with the same. Among his important works may be mentioned the "Zoology and Geology of Abyssinia," the "Zoology and Geology of Eastern Persia," the "Manual of the Geology of India," written in collaboration with the late Mr. H. B. Medlicott; the Mammalia and the Geology of the Second Yarkand Expedition, and the volume on Mammals and two of those on Birds in the "Fauna of British India," of which series he was the editor.

The Origin of Salamanders.

At the conclusion of an elaborate memoir on the development of the vascular and respiratory systems of the Australian lung-fish (*Ceratodus fosteri*), published by the New York Academy (Mem. II., part 4), the author, Mr. W. E. Kellicott, remarks that the main object of his investigation was to obtain evidence with regard to the relationship of the lung-fishes, or Dipnoi, to other groups. "It is impossible to believe," he observes, "that the Amphibian resemblances seen in *Ceratodus* in the development of the vascular, respiratory, and urino-genital systems, as well as throughout the earlier processes of development, are in the nature of parallelisms. In the light of their embryology it is impossible to believe that the Dipnoi and the Amphibia are not closely related, and that they have not travelled for a time along the same path at some period during their history." If this view is to be accepted, we must apparently regard the early lung-fishes as the direct ancestors of the extinct primeval salamanders, or labyrinthodonts. A further inference would seem to be that the gills of modern salamanders (which in certain kinds are retained throughout life) are directly inherited from fishes, and not, as has been suggested by some, a new and independent development.

A New Group of Extinct Reptiles.

In a recent issue of the *Memoirs* of the California Academy of Sciences (Vol V., No. 1) Mr. J. C. Merriam describes a group of extinct marine reptiles from the Triassic (Upper New Red Sandstone) deposits of California, which he regards as representing a new order, the Thalattosauria, typified by the genus *Thalattosaurus*. In many respects these reptiles resembled the ichthyosaurs, or fish-lizards, having the eye similarly furnished with a ring of bony plates. They are, however, broadly distinguished by the upper temporal region of the skull, which has an upper and a lower bony arch, and likewise by the character of the dentition, which takes the form of flattened, crushing teeth, some of which are situated on the palatine and vomerine bones. From these and other features the thalattosaurians appear to be most nearly allied to the rhynchocephalians, as represented at the present day by the New Zealand tuatera (*Sphenodon*), to which they appear to present the same kind of relationship as is borne by the extinct sea-serpents (Pythonomorpha) to the lizards. If this be so the Thalattosauria might perhaps be best regarded as a sub-order of Rhynchocephalia. Be this as it may, the special interest attaching to the group is the evidence it affords of the independent adaptation of yet another type of reptile to the exigencies of a marine existence, and this, too, at an early period of the earth's history.

The Origin of Mammals.

In a paper communicated to the March issue of the *Zoologischer Anzeiger*, Dr. Sixta, of Bohemia, discussed the evidence at present available with regard to the ancestry of mammals and fully endorses the view of those who hold that the group is directly descended from reptiles, and has no near kinship with amphibians. As regards the earlier stages of development, Dr. Sixta points out that the Australian duck-bill, or platypus, on the one hand and reptiles on the other are intimately related; the resemblance, in all stages of development, being most significant when the duck-bill is compared with the chelenian group (turtles and tortoises). The chief features in this resemblance were, according to Dr. Sixta, noticed independently by himself and by Dr. Hill, of Sydney, as the result of different modes of investigation, and may therefore be regarded as well-founded. That reptiles were the direct ancesters of mammals is now, in the author's opinion, an ascertained fact.

Papers Read.

At the meeting of the Zoological Society, on May 16, Mr. O. Thomas described a new South African golden mole. Mr. F. E. Beddard contributed a paper on the cranial arterial system of birds and reptiles. Sir H. H. Johnston criticised Mr. Rothschild's views with regard to the classification of man-like apes, while Mr. K. Andersen discussed certain kinds of horse-shoe bats. On behalf of Dr. E. Bergroth, a communication was read on the stridulating organs of certain hemipterous insects. Dr. P. C. Mitchell discussed the anatomy of the Limicolina birds, and Mr. R. I. Pocock redescribed the Hainan gibbon. At the final meeting of the session on June 6, Col. C. Delmé-Radcliffe gave an illustrated account of the natural history of West Uganda. Mr. M. Jacoby described new forms of *Œdionychis*. Dr. Mitchell discussed the mammalian intestinal tract. Dr. H. Gadow read a paper on the distribution of Mexican amphibians and reptiles. Mr. G. A. Boulenger described new reptiles collected by Dr. Gadow, and also new reptiles and amphibians from South Africa. Mr. Beddard referred to features in the anatomy of certain lizards. Mr. R. Assheton reported on the development of the spiny mouse. The Rev. S. Gorham described new South African beetles, and Baron F. Nopcsa discussed the position of one of the bones in the skeleton of Diplodocus.

REVIEWS OF BOOKS.

The New Knowledge, by Robert Kennedy Duncan (Hodder and Stoughton; price 6s. net).—Let nobody be discouraged by the title of "The New Knowledge" which Robert Kennedy Duncan has given to a volume which sets out, in language which is plain-spoken and easily understood, a good many of the new views in chemistry and physics that the lately imagined anatomy of the atom has created. Let them also, while reading his preface, forgive him for the expression that "in science when a new Alaska is discovered there is a rush of tenderfeet to the district"—for the sake of the germ of truth it contains. What Professor Duncan means is that when an attractive theory is started, such as that the line between force and matter is indiscoverable and perhaps does not exist, there are hosts of raw speculators, who, having been at no pains to arrive at this theory by the slow process of ascertained facts, make up for their lack of knowledge or industry by windy forecasts of what may possibly turn out to be true. Such, for example, are the immature students who announce that in radium's activity lie the germs of life. Professor Duncan's method is not this. He wishes clearly to set out without speculation, without surmise, and as simply as possible, the new conceptions of matter, and to show how they are related to one another, and how they are mutually interdependent. He considers, therefore, the later ideas concerning the implied meanings of the terms Matter, Energy, and Ether; and the consequent importance of the symbols, atom and molecule. Thence he shows how the Periodic Law, governing the structure of the elements which atoms build, took a further step along the road of theory; and, after that, how the theory of the travelling corpuscle, the "ion" of a gas, arose. The relation of the corpuscle, and the force with which the corpuscle is charged, lead up to the confirmation by solids of the laws suspected as existing in gases. Finally, the re-determination of these facts by the observed phenomena of radio-activity is considered, and the reasons for formulating an electric theory of matter, and for regarding the atom as a planetary system of ions or forces, are shown. Professor Duncan has brought together a number of modern theories; he has considered them not critically perhaps, but logically; and he has shown how they are related to one another. His volume is one which can confidently be recommended to that vast army of inquirers who, not themselves being scientific students of physics, are yet possessed of trained intelligence, and who want a good book on the whole subject.

A Manual of Quaternions, by Charles Jasper Joly, D.Sc., F.R.S. (Macmillan; price 10s.).—Professor Joly modestly describes his volume on Quaternions as introductory to the works of Hamilton, the great expositor of a new mathematical method; but it is a great deal more than that. It is a digest of the works of Hamilton, of Tait, and of other mathematical essayists in this subject; it embraces many results which have appeared in the publications of learned societies, and many others which are new; and so is to be regarded rather as a definition of the uses, the applicability, and the possibilities of Quaternions in mathematical usage as at present understood. This view, however, of Professor Joly's work is not exhaustive, for it does more than gather the theories and expositions of Quaternions under one roof; it is, if not a royal road, then, at any rate, a very carefully constructed road along which to approach them, and one which no other writer has attempted to provide. The works of Hamilton do not aim at teaching the uses of Quaternions; they rather exhibit the implications, the consequences, and the hypotheses of the symbols; the student may be imagined as panting after Hamilton up mathematical heights in order to attain comprehension and power. Professor Joly's method is not the same. He exhibits the properties of the Quaternion early in his treatise; he takes the student blindfolded along one defile, and he cuts steps in which he may place his feet. The readers of this notice must pardon a slight exuberance of metaphor; our final intention is to say that Professor Joly has written a book on Quaternions which will be invaluable to the student. It exhibits the practical uses of the Quaternion in working out mathematical problems; its own methods are developed with admirably patient clearness; and it is introductory to the works of Hamilton in the sense that study of it will open up fields of mathematical inquiry which hitherto have been worked by the few rather than by the many.

The Evolution of the World and of Man, by George E. Boxall (London: Fisher Unwin, 1905).—This may very justly be called a book of nonsense. It has fallen to our lot to have to read many stupid or indifferent books on the evolution theory, but a more pitiful muddle of fact and fiction than is to be found within the two covers of this volume has, we venture to say, never before been offered to a long-suffering public.

The author assures us that this work was undertaken "not so much for the advancement of science . . . as for the benefit of the man in the street—that is to say, the common people"! We shall be surprised if "the man in the street" does not show discrimination enough to leave this pretentious guide to knowledge severely alone, though, as a rule, we must sorrowfully admit "the common people" are but too ready to read stuff of this kind. In like manner they run after patent medicines, patent foods, faith healers, and other quackery.

By way of a sample of what is offered for the consumption of "the common people," we give one or two illustrations. Thus, "For the production of young" we are told "the female supplies the protoplasmic base in the shape of a seed or an egg, which is fertilized by the male introducing into it matter containing the necessary life germs!!" Again, "But the change of form from one order to another—as from univalve crustaceæ to bivalve, from these to the articulated shell-fish, or from these to the vertebrates—marks an era in evolution"!!! Man we are told has been evolved from a creature closely resembling the marsupial Koala, which, for want of a better name, he calls "the Menschensvorgänger, or Menschensvorfahrer, the progenitor, ancestor, or precursor of man"!! Shades of Darwin and Huxley, what are we coming to?

But why go on? We have surely said enough to show that no words of condemnation can be too strong for this jumble of silliness. W.P.P.

Some Elements of the Universe Hitherto Unexplained, part I., by A. Balding (King, Sell, and Olding; price 1s. 6d.).—Presumably this book would not have been written had the author fully grasped the significance of "relative motion," "instantaneous eclipse," and other well-known ideas. Before reaching Chapter I. we find a list of definitions, some of which might have emanated from a Junior Science Form, *e.g.*, "Quadrature—A quarter of the heavens or a point intermediate between directly opposite parts of the sky." This is discouraging and tends to render us more critical. Some of the statements are not so clear as the above sample. The author proceeds to account for the conservation of energy in the solar system by the motion of that system in space, and insists on dealing with "real paths." This is tantamount to finding all motor-cars guilty of "contravening the Act" by travelling (many of them backwards, sideways, or even vertically) at a speed never less than 20,000 miles an hour. The motion of Halley's comet and of the earth are treated in this unnecessarily complicated manner, and then the author falls foul of the accepted explanation of the Equation of Time, said to be due partly to the eccentricity and partly to the obliquity of the earth's orbit. The first part is confessedly inadequate by itself; the second, says our author, *does not exist*. How would he deal with an obliquity of 90°? Again, though it is obvious the solar day must be longer when the earth is moving faster in its orbit, he professes to find this an enormous difficulty only to be explained from his new point of view. His simple derivation of a new value, 234°, for the longitude of the solar apex, from the radiants of meteors, is unfortunately quite unsound, as the meteors are not independent of the solar system, even if we grant the accuracy of a mysterious table of "true radiants."

Our Stellar Universe: A Road Book to the Stars, by T. E. Heath (King, Sell, and Olding, Ltd., 1905; pp. 74; 5s. net).—The author has introduced a most interesting scheme of presenting the members of the stellar universe to the popular as well as the general scientific reader. The general impression after reading many astronomical treatises is that the stars are so far removed that the only possible conception of them is as if they were lying on the surface of a sphere, all at practically the same distance. The present book is to show that, with the most recent and authentic values of stellar parallax, it is conceivable to picture many members of the stellar universe as situated at various distances from the Sun. Not only this, but

it may be that a more correct idea of the relative importance of the various bodies can be thus obtained. The unit on which all the measurements are made is the light-year, and there is a fortunate coincidence in the fact that *if the distance which light travels in one year be represented by one mile, then the distance of the earth from the Sun will be represented by one inch on the same scale.* Based on this idea, a series of maps are presented, showing the positions of the members of our solar system, all stars within the distance of 60 light-years, and those within 430 light-years. These are compared with known terrestrial distances in order to fix ideas. Next an endeavour is made to present a stereoscopic chart of the stars, the size of the relative images being made proportional to their *sun-power*. The distance between the two images is taken as 107 light-years, and the distances plotted according to the best determined parallaxes. The stereograms given are very interesting, but, beyond giving a concrete illustration of the effect of parallax, cannot be considered as showing the actual distribution of stars in space. An appendix contains useful lists of stellar magnitudes, spectral types, and parallax values.

Our Stellar Universe, by T. E. Heath (King, Sell, and Olding, Ltd., 1905; 3s. net).—This little volume contains six stereograms of the sun and surrounding stars, and is intended as a companion to the author's larger work above mentioned. An index of all the objects shown on each chart is included, with the individual magnitudes, comparative sun-power, and spectral type.

The Hand Camera and What to do With it, by W. L. F. Wastell and R. Child Bayley (Iliffe and Sons; price 1s. net).—The photographic possibilities, and the principles that underlie them, in the use of hand cameras is a very large subject. But practical work of the kind that has come to be known as "snap-shotting" is so simple that those who indulge in it are apt to underrate the value of a general knowledge of the facts that their results depend on. All such, as well as beginners in the art, will reap considerable advantage without much intellectual effort by reading this volume. The authors deal with the purchase of a camera, the several types of cameras and their various parts, the manner of their use, the development of the negatives, and the preparation of prints and enlargements from them. The information given is practical and reliable and well selected. The volume takes the place of one written a considerable time since by Mr. Welford, and perhaps this accounts for the inclusion of the "uniform system" of marking lens diaphragms, which was never widely adopted, and was officially withdrawn many years ago by the Royal Photographic Society, who were responsible for its introduction. Half-a-dozen good reproductions of hand-camera pictures are given, four of which are of architectural subjects, and serve to show the use of the method in a sphere that too many regard as altogether outside its scope.

The Nature of Explosions in Gases. H. B. Dixon, F.R.S. (Henry Frowde; 1s. 3d. net).—This is the tenth Boyle lecture, delivered before the Oxford University Junior Scientific Club, and deals in particular with the mode in which flame is propagated in explosions and the nature of the chemical reactions occurring. Reference is made to the fact that it was while repeating Bunsen's work that he discovered that a dried mixture of carbonic oxide and oxygen would not explode under the action of a spark which readily kindled the moist mixture. The main part of this lecture is concerned, however, with the *rate* of explosion. Berthelot showed this rapidly increases from its point of origin until it reaches a maximum which remains constant however long the column of gases may be. Mr. Dixon considers that the wave must be propagated not only by the burnt but equally by the unburnt molecules (with which the former exchange velocities), and that therefore half the unburnt molecules are heated by the collision before they are burnt. He finds an extraordinary close agreement between the rate calculated from this point of view and the actually observed rates. Some photographs of compression waves through heated gases are reproduced and discussed.

We have received **Electricity** No. 21, Vol. XIX; and **The Indian Electrical and Mechanical Textile News**, No. 8, Vol. II. (Bombay), containing amongst articles of interest on electrical and other topics a capital portrait of Sir Joseph Wilson Swan, F.R.S.

Suggestions Towards a Theory of Electricity Based on the Bubble Atom. John Fraser.—This is a reprint from the Proceedings of the Royal Society of Edinburgh. It is very difficult to appraise the theory which is here presented, because the author is not very clear in the way that he brings it forward. It is obviously highly original, although it bears certain resemblances to Osborne Reynolds' theory of matter. On both theories matter is supposed to be represented by gaps in the ether. On Mr. Fraser's theory the ether is prevented from falling into these gaps by the rapid motion of the particles forming the surface of the gap. We cannot follow the author into his applications of his theory to the elucidation of the electrical properties of bodies. But we must remind him that a tremendous quantity of experimental facts are now known, and any theory which hopes for a long life must be capable not only of explaining these but also of keeping step with the rapid progress of discovery. If Mr. Fraser will find some friend more skilled in the art of advocacy than he seems himself to be, it is possible that the numerical correspondences which he displays in a table at the end may be shown to have a great value in guiding theoretical physicists to a correct view of the constitution of matter.

Practical Gum-Bichromate, by J. Cruwys Richards (Iliffe and Sons; price 2s. 6d. net).—This process, which has lately been in great favour with those who like to alter their photographic results to suit their taste, is here described by a practised hand. The directions are so plain and straightforward that anyone may follow them; but, of course, the worker's success, from a pictorial point of view, must depend upon his skill and artistic knowledge, for this alone can guide him in the "local treatment," and the putting in of "bright specks" by means of "the point of a penknife, or a dry brush, or anything else that experience may dictate." The author has given his own methods of work and his own preferences; but he has added the formulæ for coating the paper as used by several other well-known and successful workers of the process. The illustrations are excellent guides to the appearance of prints at various stages of their production, especially in the multiple printing methods.

Unbeaten Tracks in Japan, by Isabella L. Bird (Mrs. Bishop) (London: John Murray, 1905 [Popular Edition]; 2s. 6d.).—In issuing a cheaper and popular edition of this charming volume we venture to think some intimation should have been given to the effect that this book is concerned with Japan as it was some seven-and-twenty years ago. It would also have added much to the convenience of the reader if the full dates of the several letters, which make up the chapters of this work, had been added. Only here and there do we get anything nearer than "May 30" or "August 24." The first letter appears to have been written on May 21, 1878, the last on December 18 of the same year.

We suspect that the horrible neglect of sanitation so vividly described by Mrs. Bishop is to-day, for the most part, a thing of the past, even in the out-of-the-way regions described. Certainly we hope that the unspeakable cruelty which appears to have been practised on horses has long since ceased.

This book is too well known to need a long description. In its new and most attractive form it should gain a large number of fresh readers.

Wasps Social and Solitary, by George W. Peckham and Elizabeth G. Peckham (A. Constable and Co.; price 6s. net).—It is difficult for the casual reader to ascertain the exact object of this book, and whether it is intended for the nursery, schoolroom, or as a scientific treatise. The plain and childlike language and the simple and, we may say, unscientific methods of observation described would lead one to suppose its object was to instil into the juvenile mind an interest in natural history. Yet there is something more than this in the book. The careful observations noted and recorded have their value to the student, and the habits of some species of wasps are well worth noting and recording. The detailed account, for instance, of an Ammophila making its nest in the ground, filling up the hole, and then pounding in the grains of sand by means of a small pebble held in its mandibles, is certainly most interesting. The illustrations are by James H. Emerton, whose age is not given, but we should doubt whether his talents, when he grows up, would qualify him for Academic honours.

XUM

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

The Action of Hydrogen Peroxide on Photographic Plates.—Dr. Chiri Otsuki has made a communication (Jour. Soc. Chem. Ind., 1905, p. 575) on this subject, in which he confirms many of the results obtained by Dr. Russell some years ago. What seems to me the most important detail in this communication, though the author appears to regard it as of very little importance indeed, is the statement that a plate that had been acted on by hydrogen peroxide and that would have given an image by development, partly lost the possibility of development by "laying the photographic plate for eleven minutes in water," and that "after leaving it one hour in water after the exposure no picture of the hole was obtained." It seems that Dr. Otsuki's only conclusion from this is that the developable possibility is due to something (hydrogen peroxide) condensed on it, and that may be washed off or out of it. But developable silver bromide cannot be watered back into the undevelopable variety. If the peroxide can be washed away and leave the plate unaffected, then it does not produce the developable condition at all, but merely co-operates with the developer, in the absence of light, to reduce the silver bromide to the metallic state. Or it may be that the developable condition produced by a form of radiant energy emanating from the peroxide is destroyed by the soaking in a weak solution of the peroxide, though this latter explanation appears hardly tenable in face of the fact that Dr. Luppo-Cramer in his experiments immersed the plates in solutions of hydrogen peroxide. In any case this possibility of washing away the peroxide, and with it any effect that it may have produced, is of the greatest importance, if it can be confirmed. Theories ought to count for very little while facts are in doubt, therefore I do not think it worth while to refer to those put forward by Dr. Otsuki, especially as they appear to me to be founded on many false assumptions. I still think that some of the results obtained by Dr. Russell and those who have followed him cannot be explained on the simple vaporization theory, and I see no reason to qualify the remarks I made on these experiments seven years ago, and in the last January and February numbers of this journal.

The Spectrum as a Photographic Test.—It is difficult for the person who has not been scientifically trained to appreciate the statement that the spectrum is, and must be, the only final test object in all experiments concerning colour sensitiveness, colour reproduction, and the like. It seems to be a common idea that scientific instruments can be used and the results they give interpreted by anyone who can use the instruments in the sense in which one uses a tourist's telescope. Of course, this is a grave error, but it accounts in large measure for the ideas held by many that spectrum tests are deceptive, that as spectra "do not grow on trees" they are not suitable objects to work with in seeking for methods of photographing Nature, and that a process may be right spectroscopically but not right when tested with pigment colours. The expression "the spectrum," that one is forced by custom to employ, is deceptive, for it often conveys the impression that there is a spectrum or some particular spectrum that is the standard spectrum, and so hides from the merely practical mind the fact that spectra are as numerous as lights—indeed, may be far more numerous, and that in dealing with a spectrum one has the given light simplified by being separated into its component parts. But this very simplification when unwisely done may be a source of confusion and error, as if one in seeking for the beauties of language in a piece of writing were to dwell unduely upon the etymology and the spelling of the words.

A spectroscope is really a very dangerous guide in the hands of those who do not thoroughly understand it; it is too often like a micrometer in the hands of a tailor, unnecessary, troublesome, and misleading. Those who have not made a special study of its use should have but little to do with it; they should rely upon a judicious selection of pigments or coloured glasses. With these a great deal can be done; perhaps, indeed, all that is necessary for practical purposes. But at the same time, final and inclusive work can be done only spectroscopically, and only by one who is really expert in the use of the instrument for the particular purpose required.

For ordinary photographic purposes in connection with colour, I think that the chief difficulties peculiar to this kind of work result from the unequal dispersion given by prisms, the employment of a too small or too large dispersion, and the giving of unwise exposures. It is generally desirable to give a series of exposures in geometrical ratio, and it may be necessary to reduce with a coloured screen the light that is most active. Of course, there are many other experimental difficulties which are common to all spectroscopic work, and others common to all photographic work.

Oxidation of Sodium Sulphite Solutions.—The oxidation of sodium sulphite by exposure to the air takes place far less readily than is often supposed. The efflorescence on the crystals has been taken by many chemists as evidence of the presence of sodium sulphate, whereas it is due merely to the loss of water of crystallization. Solutions of the salt are also stable if preserved with common care. Messrs. Lumière and Seyewetz have recently observed that they are even less liable to oxidation if a small quantity of a developer is added, and they give the following list, placing the substances in order of their effectiveness. Hydroquinone is the best; then follow, paraamidophenol (the active agent of "rodinal"), glycin, paraphenylenediamine, catechol, metol, "metoquinone," amidol, adurol, edinol, and eikonogen. The addition of alkalies or their substitutes, such as acetone or formaldehyde, diminishes the preservative action. Hence the idea that a one-solution developer, especially if made with hydroquinone and also in the case of "rodinal," is peculiarly free from liability to spoil by exposure, seems to be founded on fact.

Competition.—The Thornton-Pickard Manufacturing Co., of Altrincham, are offering several series of cash prizes for photographs taken under conditions that will be sent on application. The entries must be received before October 1.

The Potentia Organization.

AN international organization is being formed by a number of influential representative men to establish amongst nations a mutual relationship and co-operation for the diffusion of accurate information on events effecting the peace of the world. Sir Vincent Caillard, Professor G. H. Darwin, and Sir Michael Foster are the English representatives.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Royal Microscopical Society.

JUNE 21st, at 20, Hanover Square, G. C. Karop, Esq., M.R.C.S., Vice-President, in the chair.—Three old microscopes were presented to the Society's collection by Mr. C. L. Curties. A noteworthy donation to the Library was the concluding part of Dr. Braithwaite's "British Moss Flora," the publication of which extended over 25 years. Dr. Lazarus-Barlow exhibited and described a new form of warm stage, devised by him, which could be heated by oil or gas. The regulation depended upon the expansion and contraction of a fixed volume of air, acting through a manometer upon a delicately-balanced lever, at one end of which a silver rod was carried in a horizontal position, the flame being applied to one end of the silver rod, while the other end, which was bent downwards, dipped into a paraffin bath attached to the side of the stage. As the temperature of the stage increased, the contained air expanded, and acting on the manometer caused the lever to raise the silver rod and so to practically withdraw the bent portion from the paraffin bath. Mr. C. R. C. Lyster also exhibited an improved form of warm stage, heated by electricity. Such warm stages are generally heated by resistance coils, but the variations in the intensity of the ordinary house current render the temperature variable, but Mr. Lyster found he could maintain a perfectly even temperature by using cryptol as a resistance, whilst the amount of current did not exceed 150 milampères. Mr. C. L. Curties exhibited an arrangement for obtaining dark ground illumination with high powers by a stop over the objective, which was suggested to him by a contrivance of Leitz. Mr. Curties observed that only in certain cases were the images of the markings on diatoms shown by this means to be considered as trustworthy evidence of their real structures. Mr. Rheinberg called attention to an experiment, showing that the appearance of a grating could be produced in the field of the microscope without there being anything on the stage. The lines seen were achromatic interference bands, produced with the help of two of Thorp's gratings of equal pitch placed behind the objective. Mr. Rousselet called attention to a living specimen of *Plumatella punctata* (*Hancock*), sent by Mr. Hood, of Dundee, which has apparently not been recorded in England since its discovery by Hancock in 1850. It differs from other species of *Plumatella*, mainly in having a soft, transparent ectocyst. Mr. Nelson communicated a note on the Tubercle Bacillus, and Mr. A. E. Conrady gave a *résumê* of his second paper on "Theories of Microscopic Vision." The proceedings concluded with an exhibition of fine zoological lantern slides, lent by Mr. A. Flatters.

The Quekett Microscopical Club.

THE 423rd ordinary meeting was held on June 16th, at 20, Hanover Square, W., the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair.

Mr. W. Wesché, F.R.M.S., gave an abstract of his paper on "The Genitalia of *Glossina palpalis*," the Tsetse fly, the host of the "sleeping sickness" organism. This was shown to be homologous with certain other flies, though differing in the presence of a double lever at the extremity of the central organ, a feature which also occurs in the cockroach.

Mr. Julius Rheinberg, F.R.M.S., showed an experiment on the production of achromatic interference bands in a new manner, which formed the subject of a paper which he had recently read at the Optical Convention. Certain experiments in connection with the theory of microscopic vision had led to the curious result in question, which amounted in effect to producing in the microscope, on the object stage of which a piece of paper having a large perforation had been placed, the appearance as if a grating had been placed over it, the lines appearing perfectly sharp in black and white.

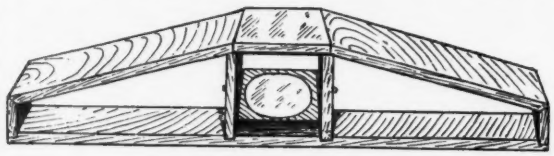
Mr. Rheinberg gave a description of the manner in which this striking interference image was produced.

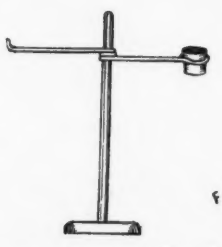
Mr. Wesché then gave a popular lecture on "Pond Life," which he hoped would encourage any novices who might be present to take up this fascinating branch of microscopy. It was illustrated by a number of lantern slides prepared from Mr. Wesché's drawings and designed to show the objects under dark ground illumination.

The next general meeting of the Club will be on October 20th, but the usual fortnightly meetings will be held during the vacation for gossip and exhibition of objects. There are also several excursions during the summer months to various collecting grounds. Visitors will be welcomed to both meetings and excursions, and may obtain full particulars on application to the Hon. Secretary, Mr. A. Earland, 31, Denmark Street, Watford.

Home-Made Dissecting Stand.

I HAVE been several times asked to recommend a dissecting stand, and though for convenience the stands made by Zeiss, Leitz, and Reichert in various patterns cannot well be improved upon, still the cheapest of them costs, with two lenses, a couple of sovereigns, and





it may interest many of my readers if I describe here a stand which can be made at home by anyone who can do a little carpentering and which need cost only a few shillings. A reference to the accompanying drawings is almost self-explanatory. The total length of the stand should be about 14 inches, and the width about

four inches. The sloping rests for the hands might be about two inches high at the lowest ends and four inches at the highest, but these measurements should be governed by the size of the mirror, which must have ample room in which to swing. The mirror itself is a simple round penny mirror, such as can be bought at almost any toy shop, the larger the better. It is deprived of its metal cover and let into a piece of wood, which swings on wooden or metal pivots between the two centre uprights of the stand. The simplest way in which to make the support for the mirror is to carefully cut a hole of the proper size in a piece of stout fret-wood, and to back it with another piece of fret-wood, glueing the two together and mounting them on a cross beam, the projecting ends of which are carefully shaped circular and fit fairly tightly into corresponding holes. This piece of wood could also be hinged to the bottom of the stand, but in that case the mirror would not remain central when tilted at an angle. A little more skill would be required to arrange universal movements, but they are really not necessary. The stage is a piece of plate glass, 5 by 4 inches, ground at the edges, and can be ordered from any glass shop for a shilling or so. It lifts out if necessary. Two pieces of cardboard of the same size should be cut to go underneath when required; both should be covered on one side with black and the other side with white paper, and one should have a hole about 1½ inches in diameter in the centre. The whole stand might be made of wood ⅜ inch thick, mahogany or walnut being preferable to pine, and the dove-tailing or grooving should be done and finished off as carefully as possible.

The holder for the lenses can be made, as illustrated, by fitting a piece of ¼-inch brass tube about eight inches high into a small stand about 2½ or three inches in diameter. A piece of springy ⅛-inch brass wire is then rolled several times round the upright, as shown; one end is turned up about three inches away from the stand, and the other end is shaped into a ring to hold a watchmaker's eye-glass. This last can be bought anywhere for about 10d. or a 1s., and makes a most useful dissecting lens. On the turned-up end can be put an ordinary pocket magnifier in ebonite mount, such as can be bought for a shilling and upwards, according to the number of lenses.

This stand, simple as it is, will be found a useful and efficient piece of apparatus. It will be money well spent if the worker provides himself, however, with one of the beautiful aplanatic lenses sold by all the principal opticians. They give exquisite definition, together with a flat field, and being much less tiring to the eyes are excellent for dissecting, and are also the most perfect of those magnifiers which the real microscopist can always bring forth from his pocket when wanted. The most useful powers do not exceed ten diameters, and a lower power gives a larger field and greater working distance. Perhaps six is the most useful and convenient magnification.

Botanical Microscopical Slides.

MR. A. PENISTON, of 5, Montpelier Terrace, Leeds, has sent me a catalogue of botanical slides which contains a novel feature in that it not only gives the principal features of the slides referred to, but in many cases adds outline descriptive illustrations. Many of the slides are also quite out of the ordinary run, amongst which I observe a slide of œdogonium, showing oogonia and so-called "dwarf males," early stages in the development of antheridia, developing pollen-tubes, etc. The prices are very moderate and the whole list shows evidence of having been the work of a botanist and not a mere mounter.

Answers to Correspondents.

O. H. Sargent, York, W. Australia.—I am afraid that the difficulty to which you refer is, as you suggest, inherent in deep eyepieces when used with ordinary achromatics. Few of such objections will satisfactorily bear eyepiecing above 10 times, and even then the loss of light and depreciation of the image is noticeable. If your eyepiece is capped, it is just possible that this is not correctly adjusted. Possibly also you are using a larger cone of illumination than your objective will stand. Few objectives will bear a cone equal to their own aperture and a two-thirds or three-quarter cone is generally ample. You can judge of the size by removing the eyepiece and looking down the tube. All camerae lucidae require considerable practice before satisfactory results are obtained. You would probably find the Swift-Ives type as easy to use as the Abbe, but it too requires practice. The great secret is the careful adjustment of the light, and I think the best way is to have two lamps, one to illuminate the object in the microscope and one to illuminate the paper on which you are drawing. The flames of each lamp can then be carefully adjusted, until the brightness of the microscope field does not overpower the illumination of the paper, or *vice versâ*. You will find very different adjustments are required for any change of magnification. I think you will find an ordinary twelfth immersion objective of N.A. 1·25 or so perfectly satisfactory, and there is very little to choose between those made by the leading makers. The cost will be £5. But all your objectives must be used with the tube-length for which they are corrected. As your eye becomes more trained you will perceive this yourself, especially for such critical work as cytology. The study of the pollination and fertilization of W. Australian plants ought to prove an almost inexhaustible field for work of all kinds if you work at it steadily and earnestly.

A. I. Robinson, Portsmouth.—I have had no experience myself in mounting diatoms in either carbon bisulphide or quinidine, and the nearest reference I can give you is a method by Mr. A. W. Griffin on mounting in solution of phosphorus in carbon bisulphide, which has a very high refractive index but needs great care. As a precaution against getting the phosphorus under the finger nails it is best to well oil or vaseline the hands. Procure some clean, semi-transparent phosphorus, cut off some pieces under water with a penknife, place them for a few seconds on blotting paper to free them from any least trace of water, and dissolve in carbon bisulphide, say, one drachm of phosphorus in two drachms of the solvent. When quite dissolved, slightly damp a piece of filter-paper with bisulphide, and carefully filter into a small stoppered bottle through a very small glass funnel. Support both funnel and filter paper in a basin of water to prevent accident, and have the basin handy throughout in order to place in it any article which has been touched by the phosphorus solution, in order to prevent accidental combustion. Supposing the diatoms are preserved in water or spirit, place a drop of the fluid on the cover-glass and slowly evaporate the medium over the flame of a spirit lamp or jet of gas. When the cover-glass is quite cool place on the margin of its edge a mere speck of Canada balsam, the object of which is to keep the cover, with its surface covered with diatoms, face downwards, in the centre of the glass slip. By means of a pipette take a few drops of the phosphorus solution and place them on the edge of the circle, and by capillary attraction they will be at once drawn under, displacing the air in their progress. Having ascertained that the diatoms are completely immersed in the medium, remove all superfluous particles of phosphorus with a piece of blotting paper damped with carbon bisulphide, and consign it also to the basin of water. Ring with glucine or Kay's coaguline, put aside to dry for six hours or more, ring again, and then, if preferred, ring finally with shellac, varnish or asphalt.

[*Communications and enquiries on Microscopical matters are invited and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for August.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 4.24 and sets at 7.48; on the 31st he rises at 5.11, and sets at 6.49.

Sunspots are numerous; also recent spectroscopic observations of the Sun's limb have shown many bright and active prominences.

The position of the Sun's axis and equator, required for physical observations of the Sun, is indicated in the following table:—

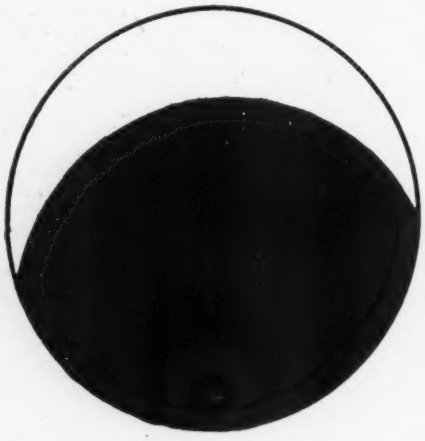
Date.	Axis inclined from N. point.	Equator S. of Centre of disc.
July 30 ..	10° 6′ E.	5° 45′
Aug. 9 ..	13° 59′ E.	6° 24′
,, 19 ..	17° 28′ E.	6° 53′
,, 29 ..	20° 28′ E.	7° 10′

An eclipse of the Sun takes place on the 30th; in this country it will be observable as a partial one; three-fourths of the diameter being obscured in the southern counties, diminishing to about one-half in the Orkneys. From suitable positions in Canada, Spain, Algeria and Egypt the eclipse may be observed as a total one.

The particulars for London are as follows, whilst the diagram illustrates the appearance at maximum phase:—

At Greenwich, partial eclipse (Sun's diam. = 1), magnitude 0·786:

Begins	Aug. 30, 11 h.	49·1 m.	a.m.
Greatest Phase ..	,, ,, 1	3·5	p.m.
Ends	,, ,, 2	15·1	p.m.



Eclipse as visible in London, 1.0 p.m. August 30.

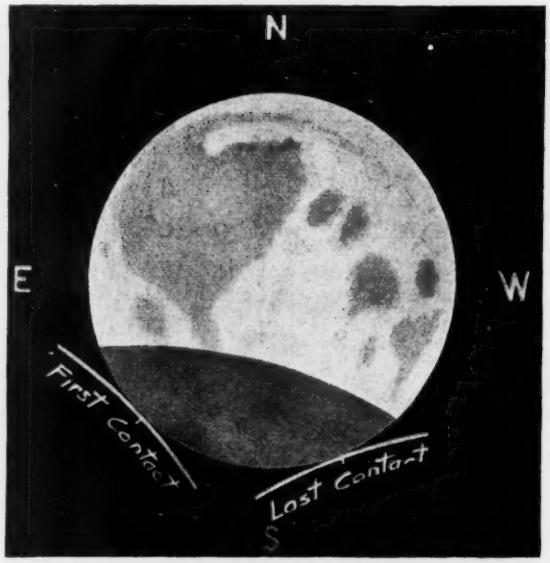
THE MOON:—

Date.	Phases.	H. M.
Aug. 1 ..	● New Moon	4 3 a.m.
,, 7 ..	☽ First Quarter	10 17 p.m.
,, 15 ..	○ Full Moon	3 31 a.m.
,, 23 ..	☾ Last Quarter	6 10 a.m.
,, 30 ..	● New Moon	1 13 p.m.

A partial eclipse of the Moon takes place on the morning of the 15th. At Greenwich, however, the Moon sets before it is quite out of the shadow.

	h.	m.	
First Contact with the Penumbra, Aug. 15	1	9·5	a.m.
,, ,, ,, Shadow, ,,	2	38·9	,,
Middle of Eclipse .. .. ,,	3	41·0	,,
Last Contact with the Shadow ,,	4	43·1	,,
,, ,, ,, Penumbra ,,	6	12·5	,,
At Greenwich the Moon sets .. ,,	4	53	,,

Magnitude of Eclipse (Moon's diameter = 1), 0·292.



Appearance of Moon at Middle of Eclipse, Aug. 15.

THE PLANETS.—Mercury, at the beginning of the month, is an evening star in Leo; he is at greatest easterly elongation on the 2nd, when he sets about one hour after the Sun. On the 30th, the day of the solar eclipse, the planet is in inferior conjunction with the Sun at 3 a.m., and at the time of the eclipse the planet is about 4° towards the S.W. of the Sun.

Venus is a morning star in Gemini, rising shortly after 1 a.m. throughout the month. On the 30th, the planet will be situated about 39° W. of the eclipsed Sun, where search should be made at the time of maximum phase, to ascertain if the planet is visible in the subdued light.

Eros is in opposition on the 7th, but being in the neighbourhood of its aphelion it is not a favourable opposition.

Mars is due south about 6 p.m. near the middle of the month, when he sets about 10 p.m. The planet is not well placed for observation, as he appears low down in the sky, and on account of increasing distance from the earth his lustre is diminishing.

Jupiter rises at 11.30 p.m. on the 1st and at 9.45 on the 31st. The planet is situated in Taurus, a little south of the Pleiades.

Saturn rises about 7.40 p.m. on the 15th, when he is on the meridian shortly after midnight. We are looking down on the northern surface of the ring which appears open at a smaller angle than of late years.

Uranus is on the meridian about 8.30 p.m. on the 15th. He is situated about 2°½ south of the 4th magnitude star μ Sagittarii.

Neptune does not rise until after midnight.

METEORS:—

	α	δ	
Aug. 10-12	45°	+57°	Great *Perseid* shower; radiant moving E.N.E. about 10 per day.